ANIMAL SCIENCE AND FOOD TECHNOLOGY

Journal homepage: https://animalscience.com.ua/en
Animal Science and Food Technology, 13(2), 71-80
Received: 01/25/2022 Revised: 03/09/2022 Accepted: 04/05/2022

UDC 664.994: 547
DOI: 10.31548/animal.13(2).2022.71-80

The Use of Inulin-Containing Raw Materials in the Technology of Sausage Production

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Abstract. Since the second half of the twentieth century, the popularity and accumulation of research on various methods of improving sausage products has been growing, which necessitates the systematisation of available information, especially regarding the use of non-traditional functional components such as inulin-containing raw materials. The purpose of the study was to analyse the scope of the research and systematise the available information on methods of improving the quality and nutritional value of sausage products, and to determine the prospects and feasibility of using inulin-containing raw materials in the formulation of sausage products to increase their consumer benefits and improve nutritional characteristics. The method of meta-analysis of evidence was applied, based on the search of literature data for the period 2001-2022 using the international scientific platform Research4Life, which includes publications indexed in Scopus, Web of Science, etc. The study used statistical data from the Organisation for Economic Cooperation and Development, the State Statistics Service of Ukraine, etc. A total of 64 articles related to the use of inulin in the composition of inulin-containing raw materials in sausage products were found, four of them about sausage with chicory, six – about sausage with Jerusalem artichoke. The article also presents statistical data on meat consumption in Ukraine and in the world, the distribution of consumer purchasing and taste preferences, and systematises the ways to improve the quality of sausages. As a result of the research, a low tendency towards an increase in demand for meat products was noted, it was found that the most promising, in terms of improving health qualities, meat products are boiled sausages, as they are in great demand among Ukrainian consumers. The most common methods of improving the quality of sausage products are fat correction and calorie reduction. research of technology of sausage products with inulin-containing raw materials. Systematization and structuring of the available array of information on the use of inulin-containing raw materials in the technology of sausage products will facilitate the establishment of the feasibility and necessity of practical application of this method of improving the quality of this segment of food products

Keywords: fat substitutes, meat products, inulin, chicory, Jerusalem artichoke, organoleptic, health-improving properties

Introduction

Analysis of the preferences of Ukrainians when choosing meat products shows that more than two-thirds of national consumption is accounted for by sausage products, which belong to instant meat products [1]. It is worth noting that the sausage market products belong to the traditional dishes of Ukrainian cuisine. Sausages are included in the list of products of the consumer basket, which is approved by the Resolution of the Government of Ukraine of October 11, 2016, No. 780 [2].

At the same time, there is evidence [3] that sausage can be harmful to health (nutritional diseases, in particular obesity, and cardiovascular disorders), mainly due to its composition, which includes natural fat as a thickener, and in cheap products, hydrogenated vegetable fats are added

Suggested Citation:
Snizhko, O., & Momot, I. (2022). The use of inulin-containing raw materials in the technology of sausage production. *Animal Science and Food Technology*, 13(2), 71-80.

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to stabilise the structure [3]. Excess lipids in the human diet combined with low physical activity lead to undesirable consequences, most often obesity [4].

Today, many scientific studies are devoted to the impact of nutrition on human health. In the last year alone, the international scientific platform Research4Life has collected more than 32 thousand sources of evidence of the direct impact of food components on the consumer [5].

According to experts, healthy sausage in the modern world simply does not exist, but the safest is boiled sausage, mainly due to the manufacturing technology [6]. It is possible to reduce the caloric content of cooked sausages by reducing the relative amount of fat in the recipe, however, without introducing any substitutes, this will lead to a deterioration in the organoleptic parameters and structure of the finished product [7]. The relevance of the research topic is determined by the necessity to analyse the existing practice of improving the quality of sausage products by full or partial replacement of fat, including at the expense of inulin-containing raw materials.

Adding dietary fibres such as inulin to meat products has become a new trend due to their potential health benefits for the consumer. Inulin is used in the food industry either alone or in combination with other related ingredients. At the same time, it is defined as a prebiotic, dietfibreary modifying, low-calorie sweetener, fat substitute, gelling agent, viscosity modifier and texture- ingredient in various food products [8].

It is worth noting that in general, the global inulin market is characterised by high competition. Most major producers are geographically located in North America and Europe. The largest players in the market are Beneo GmbH, Cosucra Group Warcoing SA, Tierra Group, Cargill, Inc. and Sensus BV [9]. The average annual growth rate for inulin is estimated to be 6.5% on the world market [10].

The purpose of the study was to analyse the statistical data on the dynamics of meat consumption in Ukraine and in the world, to examine the distribution of consumer purchasing and taste preferences; to systematise the available information on methods of reducing calories and increasing the nutritional value of sausage products, and to determine the scope of study and practical application of inulin-containing raw materials in the formulation of sausage products to improve their quality and nutritional value.

To achieve this goal, it is necessary to conduct a meta-analysis of the international and Ukrainian publications by keywords; to research and process statistical data on the level of meat consumption; to establish the feasibility of improving sausages by determining the features of consumer priorities in relation to meat and sausage products; to find and structure the available information on improving the health properties of sausages.

Materials and Methods

During the research, the methods of formal logic, analysis, synthesis, generalisation, comparative method, etc. were used, a meta-analysis of studies based on the search of literature data for the period 2001-2022 (descriptors: inulin, inulin-containing raw materials, sausages) using the international scientific platform Research4Life [5], which contains publications of such bibliographic and abstract databases of peer-reviewed literature as Scopus, Web of Science, Google Scholar and others. The paper contains statistical data from the Organisation for Economic Cooperation and Development [11], the state statistics service of Ukraine [12] and others [13].

Articles must meet the following criteria: published in English; prospective, retrospective nature of research; open free access to the text; articles were peer-reviewed; publication date ranged from 2001 to 2022.

Mathematical processing of digital material and various table formats, and visualisation of the processed data was carried out using Microsoft Office Excel with a standard set of options.

Results and Discussion

Analysis of recent studies

Meat is a concentrated source of nutrients that have traditionally been considered essential for optimal growth and development. This animal product is vital for a healthy and balanced diet. Meat products play a unique role throughout the history of human development [14]. They have always been and are an important component of the human diet, and their consumption has acquired a tendency to gradually increase both in Ukraine and around the world [11].

Meat and meat products are an important source of energy, essential nutrients such as amino acids, proteins with high biological value, b vitamins, especially vitamin B_{12} and minerals such as iron, zinc, selenium, and manganese. A large number of studies indicate that, in addition to macronutrients (proteins and lipids), meat and meat products are also rich in some biologically active components (L-carnitine, taurine) with antioxidant properties that play an important biotransformation role for consumer health [15]. There are studies confirming the antioxidant properties of L-carnitine, taurine, and L-carnosine, which are based on the ability of these substances to remove radicals and chelate (bind) metal ions with a ligand (a molecule connected to a protein) [16]. Other animal studies reported that the consumption of L-carnitine, L-carnosine, taurine significantly reduced serum triglyceride and total cholesterol levels and could prevent liver obesity [17].

L-carnitine performs several important functions in living organisms, in particular, energy production, participating in the reactions of fatty acid oxidation in the mitochondrial matrix, in the transport of activated fatty acids (acyl-CoA) from the cytoplasm through the mitochondrial membrane, thereby stimulating the processes of β-oxidation, while enhancing thermogenesis (heat production in the body) [15].

Taurine is a sulphur-containing amino acid found in nature mainly in excitable tissues such as the heart, brain, retina, and skeletal muscles. In 1985, taurine was first approved for the treatment of patients with heart failure in Japan [18]. In particular, it was claimed that taurine protects against pathologies associated with mitochondrial defects, such as ageing, metabolic syndrome, cancer, cardiovascular diseases and neurological disorders. A number of studies have confirmed the antioxidant properties of taurine and its ability to protect mitochondria from oxidative stress. In addition to antioxidant properties, the data also show the hypotensive and immunomodulatory effects of some components of meat products, the protective effect of taurine on the retina and the ability to reduce the level of free and

esterified cholesterol [19]. Peptides extracted from meat showed antithrombotic properties and cytotoxic effects against various cancer cells [15].

Despite all the advantages of food products from raw meat, nutritionists report that an excess of meat in the diet can provoke a number of diseases [20-22], including cancer [23], and, most likely, a violation of normal metabolism [4]. Sausage products are especially criticised [24]. Therefore, scientists and producers of the meat processing industry are looking for methods to improve the quality of meat products, including sausages, that would meet modern requirements for these food products.

Among the current solutions are the elimination of nutrient deficiencies and the potentially toxic compounds without reducing the organoleptic quality and safety of finished products, enrichment with natural bioactive plant compounds (antioxidants, dietary fibre) or probiotics, reduction of harmful components (salts, nitrates/nitrites, N-nitrosamines), use of alternative technologies (high-pressure processing, cold plasma [25], ultrasound) [15; 25], the introduction of monounsaturated and polyunsaturated fats [26-28] and reduction of fat content [29].

Scientists have proposed various means of reducing the fat content of sausage products, in particular through the use of lean meat and the addition of more water than in products made according to the classical recipe, they also propose the use of ingredients with low-calorie content or even those that do not contain calories at all [30] Some studies have shown that cereal and legume fibres, β-glucans, starches, gums, and pectin can be used to reduce calories and fat content in sausage products [31; 32].

Previous investigations related to changes in sausage formulation aimed at reducing fat content and improving fatty acid profile demonstrate and analyse the use of different oils (olive, soybean, flaxseed, grape seed, etc.) in liquid, encapsulated or stabilized with isolated soy protein [33].

More recent publications demonstrate the effects of the use of special gels of complex structure, which provided a combination of oils with carrageenans, gellan gum and reduced fat content in fermented sausages up to 80% [34; 35].

Most of the technological solutions for processing meat raw materials discussed above have encountered various production obstacles, in particular those related to reducing the content of animal fat since it performs important functions in determining the three main organoleptic characteristics: appearance (colour and surface uniformity), texture (viscosity, elasticity and hardness), and the intensity of taste. Loss of product weight and moisture retention capacity can also become a problem. For example, the replacement of fat in the formulation with rapeseed and olive oils caused a stiffness of meat products in the experiment conducted by R. Afshari *et al.* [8]. At the same time, they found that the samples made from similar raw materials, but with the addition of inulin (3.1%) and β-glucan (2.2%), had better organoleptic quality indicators. The study of organoleptic qualities and subjective assessment of the appetence of meat products when using different doses of rye bran and pea fiber was carried out by a group of scientists led by Ursula Kelet [36]. Pea fibre or rye bran was added to minced meat in doses of 3 to 6 g of dietary fibre per 100 g of minced meat. The sensory profile rated the meatballs in terms of smell, appearance, texture and taste and found that the addition of rye bran enhanced the grain smell, texture and taste. Pea fibre led to a more crumbly, firm, and grainy texture, especially with increasing fibre doses, while the addition of fibre did not affect subjective appetite.

According to F. Balestra [37], dietary fibre can be effectively incorporated into processed meat products as a functional ingredient with a "clean label" with a corresponding effect on the technological, nutritional and organoleptic characteristics of meat. Dietary fibres are mainly used in meat products to improve moisture retention capacity and retain additional added water, thus acting as a kind of filler. They improve the uniformity and shape of crushed meat products, and have a positive effect on the stability of the emulsion and fat retention of meat (for example, sausages). Dietary fibres are a powerful tool to change the texture and sensory properties of the finished product towards the desired profile (to add spice or increase tenderness and juiciness). Some soluble dietary fibre fractions can be useful for the formulation of low-fat meat products due to their "fat-like" behaviour.

In water systems, when stirred intensively and then cooled, inulin forms a smooth gel-like structure that provides a combination of creamy and juicy sensations in the oral cavity during the tasting of the product. This ability potentially provides it with the role of a fat substitute, without changing the rheological properties, but resembling the feeling of fatty taste in a lean meat product [38].

Thus, inulin is a fat mimetic and can be beneficially used in the technology of meat products with low-fat content and low-calorie content, including in the technology of sausage products.

Inulin in its native form is found in tubers, rhizomes and bulbs of plants of the family *Asteraceae* such as chicory (*Cichorium intybus*), artichoke (Cynara), garlic (*Allium sativum*), Jerusalem artichoke (*Helianthus tuberosus*), onion (*Allium porrum*), dahlias (*Dahlia pinnata*), asparagus (*Asparagus falcaus),* Kalgan the great (*Alpinia calcarata*), aloe vera (*Aloe vera*), elephant bread (*Amorphophallus campanulatus*), beetroot (*Beta vulgaris*), yams (*Dioscorea alata*) [39], devyasil (*Inula helenium*) [40] and some others.

Plants with a high content of inulin are usually called inulin-containing raw materials. The number one raw material with an inulin content of 42 to 76 g/100 g of dry weight is chicory roots. Jerusalem artichoke tubers also have high levels of inulin and fructo-oligosaccharides, which are 45-75.0 g/100 g dry weight [41]. Artichoke, which also contains inulin as a reserve carbohydrate, is grown mainly in the Mediterranean basin, where Italy and Spain are its main producers and consumers. The amount of inulin in the artichoke core ranges from 2-10 g/100 g of dry weight [42]. The technology of inulin production from artichoke is special because it results in a large amount of waste and up to 77% of the mass of all raw materials is lost by the food industry [41].

Due to the steady growth trend in demand for inulin, Europe will dominate the market in the near future. The interest of consumers is explained by the awareness of the importance of a healthy diet, which, according to modern beliefs, should contribute to the prevention of alimentary diseases. The consumption of food products with inulin, which is a polymer of fructase – fructan, and all fructans are prebiotics, the benefits of which are confirmed by many studies [39-41].

Among the search results, 73% of publications reported on inulin-containing raw materials as a source of inulin. Data on the use of inulin-containing raw materials in sausage products are quite limited in both international and Ukrainian sources. Among the findings are the results of comparing the quality indicators of two groups of sausages during an 80-day experiment at a storage temperature of 2 °C [43]. Both groups had the same recipe and component composition, with the exception of pork fat. In the experimental group, 5.2% of all animal fat was replaced with chicory root inulin, while the control group of sausages contained 7.8% pork fat. Control sausages were more elastic, cohesive, firm and juicy, while sausages with fat mimetic showed higher gel strength and hardness. Both groups had acceptable quality not only immediately after production but also during storage. However, the sausage with fat mimetic had lower calorie content, which is a positive change towards the health benefits of the sausage. The authors also indicate that inulin did not affect microbial growth, which was within the normal range.

The study, which was conducted to evaluate the organoleptic and physicochemical properties of lean chicken sausages with the addition of garlic inulin, showed that the fat content in sausages can be reduced from 13.67% (control sample) to 4.47-4.85% due to the inclusion of water-based inulin gel at the level of 3% At the same time, 2% of inulin contributed to an improvement in sensory qualities, such as taste and overall impression (appetite). It is noted that the content of protein, ash and moisture in the sausage samples increased with an increase in the percentage of inulin in the formulation. The authors concluded that garlic inulin can be successfully used to replace fat in sausage production without changing meat quality indicators [10].

The journal "Korean Journal for Food Science of Animal Resources" published a study on the influence of chicory on the quality characteristics of sausages. The bottom line was that chicory in the formulation of restructured sausages in general had a negative impact on the quality characteristics of the sausage, which the researchers successfully levelled by applying smoke. In conclusion, it was recommended to use chicory in restructured sausages with a reduced fat content, subject to quality compensation [44].

It is worth paying attention to several other experiments aimed at reducing calories and increasing the usefulness of sausage products, in which vegetable oil was successfully replaced by inulin in the composition of sausages to improve the physicochemical, microbiological and textural parameters. Léia ZenaideMenegas and co-authors studied the physicochemical, microbiological, and textural characteristics and stability during storage (4 °C for 45 days) of sausages with partially replaced corn oil in the recipe. They found that the addition of inulin did not change the physicochemical and microbiological parameters, but affected the texture and colour, while also softening them. The authors noted that the created product had stable quality in terms of physical, chemical, microbiological and organoleptic properties during 45 days of storage at 4 °C [45]. Also, there are results showing that reducing the fat content in emulsion-type sausages (from 6% to 18%) leads to a decrease in the energy value of the product by 20% and 64%, respectively; that inulin can be used as a fat mimetic without any significant changes in the overall perception and attractiveness of the final product [46]. Other researchers analysed four options for replacing fat with inulin in chicken sausage (25%, 50%, 75%, 100%). After the preparation of the samples, their physicochemical, textural, calorimetric and organoleptic properties were assessed. As the amount of inulin increased, the stiffness, cohesiveness, stickiness, and fibrousness decreased, but the elasticity and rubberiness of the structure increased. Organoleptic evaluation of the samples showed that as the amount of inulin increased, the average scores for colour, appearance, and texture increased, but the average scores for smell and taste decreased. Finally, they concluded that the use of inulin can be recommended as a fat substitute in the formulation of chicken sausages, provided that the dose of the component is adjusted [7].

Description of statistical data

Analysis of Ukrainian and international data suggests a minor trend of about 2% (Fig. 1) towards an increase in consumption of meat products in the world. Ukraine would have similar dynamics, but the armed aggression of Russia poses a threat to the food security of Ukraine (Fig. 1).

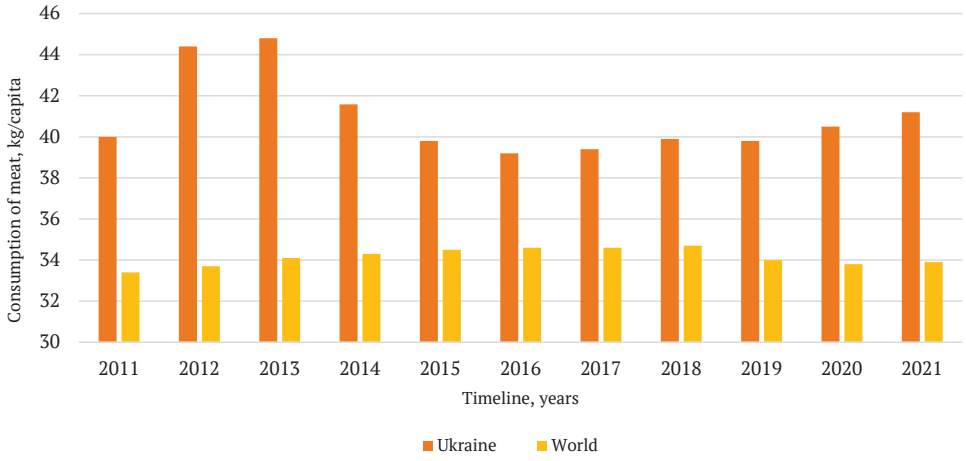

Figure 1. Consumption of meat products in Ukraine and in the world 2011-2021

Source: *compiled by the author based on data from [47]*

Over the past 10 years, meat consumption in the world has not been uniform and after rising in 2013 to a value of about 45 kg per capita per year, it fell in 2016 by 11% to 40 kg per capita. However, over the past three years, there has been a steady upward trend in meat consumption in the world and as of 2021, reached the mark of 41.2 kg per capita. In Ukraine in 2018, according to European statistics, meat consumption began to decline over the next two years and amounted to 33.8 kg per capita in 2020. However, in 2021, there was a barely noticeable increase in this indicator.

According to sources [16; 17] meat products are rich in biologically active substances – L-carnitine, taurine. The data on the content of these components in food raw materials of various origins were analysed (Fig. 2) and it was found that taurine and L-carnitine are found mainly in animal food.

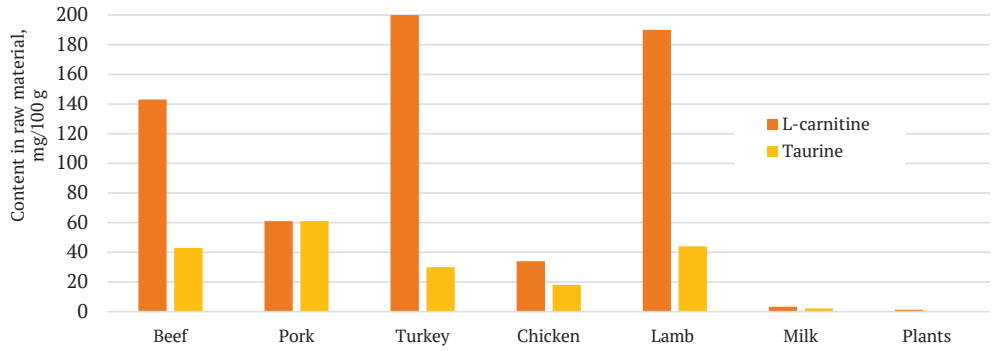

Figure 2. L-carnitine and taurine content in raw materials of various origins

Source: *compiled by the author based on data from [16]*

Turkey, lamb, and beef are leaders in the content of L-carnitine, as they have 200 mg/100 g, 190 mg/100 g and 143 mg/100 g, respectively, of this nutrient. Most taurine is found in pork, lamb and beef – 61 mg/100 g, 44 mg/100 g, 43 mg/100 g. Pork contains an equal amount of L-carnitine and taurine, which makes this raw material unique. Chicken is quite poor in carnitine and taurine compared to the previously mentioned raw materials. However, these two substances are almost absent in plants. Therefore, meat, according to this indicator, has no alternatives and is really a high-value source of necessary nutrients for the body. And, despite the decline in meat consumption, for objective reasons, meat and meat products are the most promising products for a healthy diet.

It is worth noting that among the total number of meat products the most popular in Ukraine are sausages (Fig. 3).

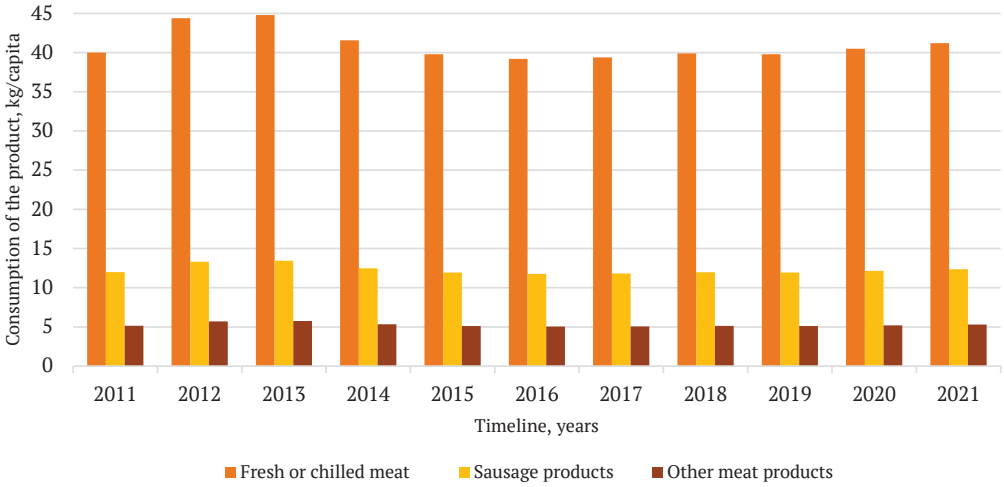

Figure 3. Consumption of meat and meat products in Ukraine 2011-2021

Source: *compiled by the author based on data from [47; 48]*

The graph in Fig. 3 shows that during the last decade sausage consumption was almost stable and averaged 12.3 kg per capita. In addition, it should be noted that Ukrainians consume 70% more sausages as compared to other meat products. Due to the popularity of sausage products, it is advisable to improve their health properties. Comparisons of opinion polls and consumer portraits taken from Ukrainian literature sources, as well as statistical data, are shown in Figure 4.

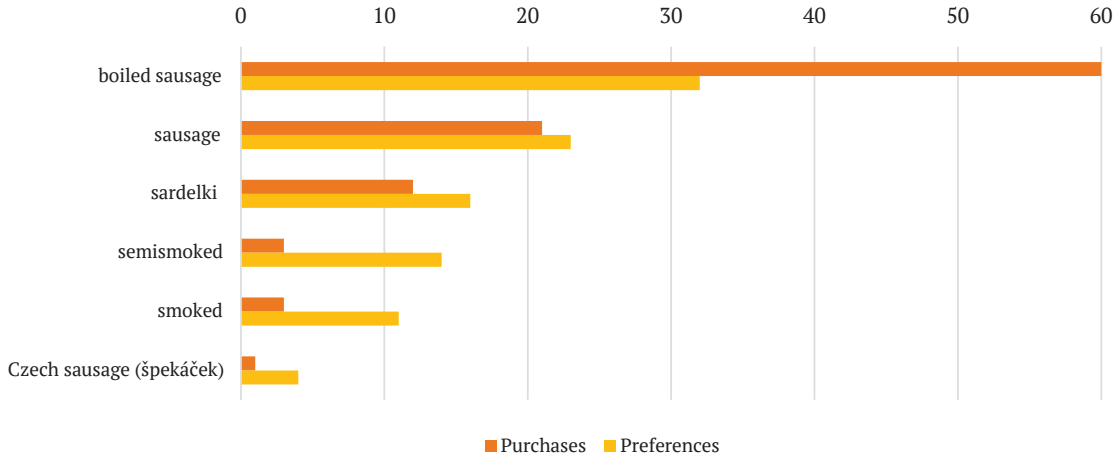

Figure 4. Distribution of consumer and taste preferences, % of respondents

Source: *compiled by the author according to [49-51]*

The analysis of consumer preferences shows that among the wide range of sausages on the Ukrainian market, respondents choose boiled sausages due to their versatility, availability and taste. The second and third most popular sausage products are sausages and sardelki, followed by semi-smoked and smoked sausages and the last place is Czech sausage (špekáček). Consumers most often buy boiled sausage, less often buy sausages and sardelki than smoked and semi-smoked. According to the data obtained through author's literature search, the replacement of fat in sausages is the most relevant area in the field of research on the quality of sausage products. When searching for the keywords "sausage" and "fat", the system offered 3,426 results, among which the predominant majority are journal articles (Fig. 5).

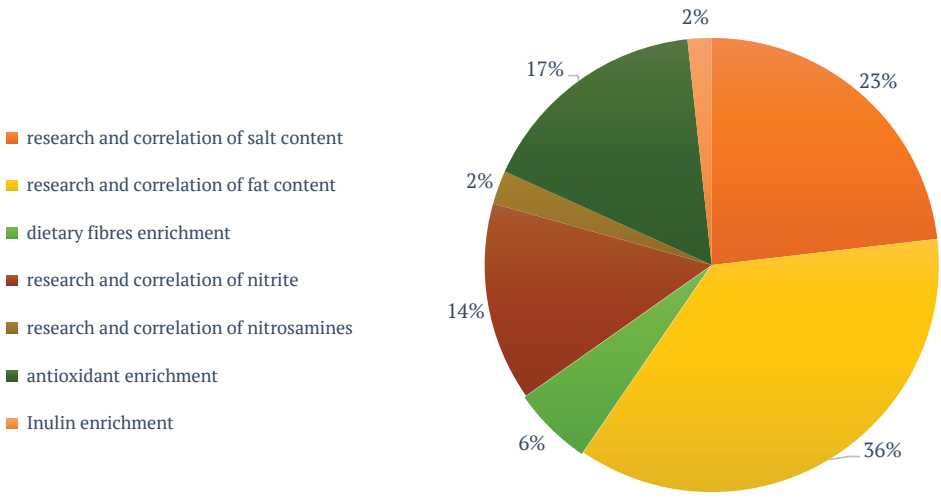

Figure 5. Research of directions for improving the quality of sausages

Sausages are popular all over the world due to the combination of several properties. First, they have a high nutritional and caloric value (406.96 kcal (or 1703 kJ) per 100 g, the average value for semi-smoked sausages). This amount is ¼ of the norm of protein and up to ½ of the norm of fat, based on the daily norm – 2000 kcal per 1 day. Secondly, sausages do not require initial heat treatment. Additional shelf life is another important characteristic of sausage products, which makes it possible to transport them over long distances for a long time without loss [52]. However, as noted earlier, sausage products also have a number of disadvantages, which are based on raw meat and animal fat.

Monitoring of freely available data on the directions of improving the quality of sausages, in accordance with modern world requirements, showed that most articles were devoted to the correction of fat content and calorie reduction – 36% (8,050 publications) (Fig. 5). The topics of research and correction of salt content – 23%, enrichment with antioxidants – 17%, research and correction of nitrites – 14% and 6% of publications concerned the enrichment with dietary fibre in general. Nitrosamines in the composition of sausages, which can be formed in the presence of amines (chemicals derived from ammonia and found in large quantities in protein products) during the technological production, culinary preparation and storage of sausages, were

mentioned in 2% (225) of the sources. Enrichment of sausage products with inulin is also not a sufficiently studied area, as only 161 articles (also about 2%) were found by relevant keywords in international databases of scientific publications.

Improving the quality of sausages is often suggested to be accomplished by introducing vegetable raw materials – protein, carbohydrate, and fat (Fig. 6). The first place is occupied by soy protein (214 articles – 42%), and the second – by oils (220 articles – 44%), among which there can be both liquid (8 articles – 2%) and oleogels (36 articles – 7%). The use of polysaccharides is proposed in 5% of articles (27 articles), which indicates incomplete development of the direction.

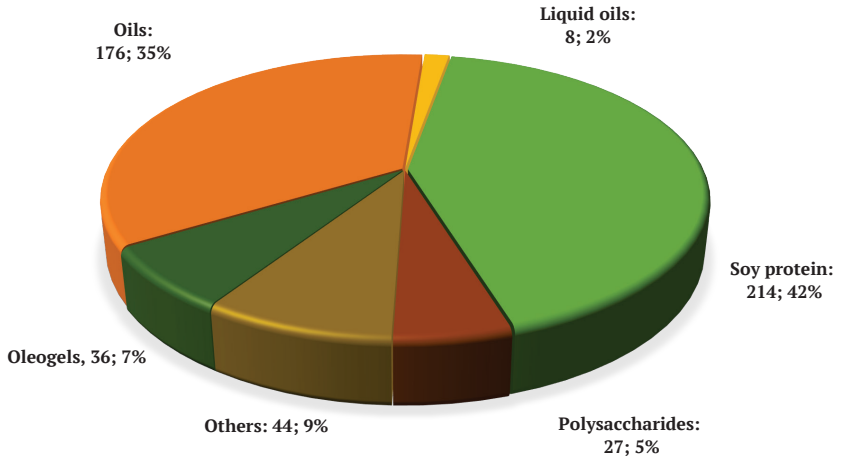

Figure 6. The use of plant components to reduce the fat content of sausages according to Research4Life publications

The scientific base of Research4Life includes 1844 articles that report on the experience of using various polysaccharides in the formulation of sausage products, among which the most popular group is “dietary fibre”, which currently has 873 (47%) publications, most of which are journal articles (Fig. 7). This group accounts for almost half of all sources found by search keywords related to the names of the group of polysaccharides and sausage products. The second half is made up of starches and other substances.

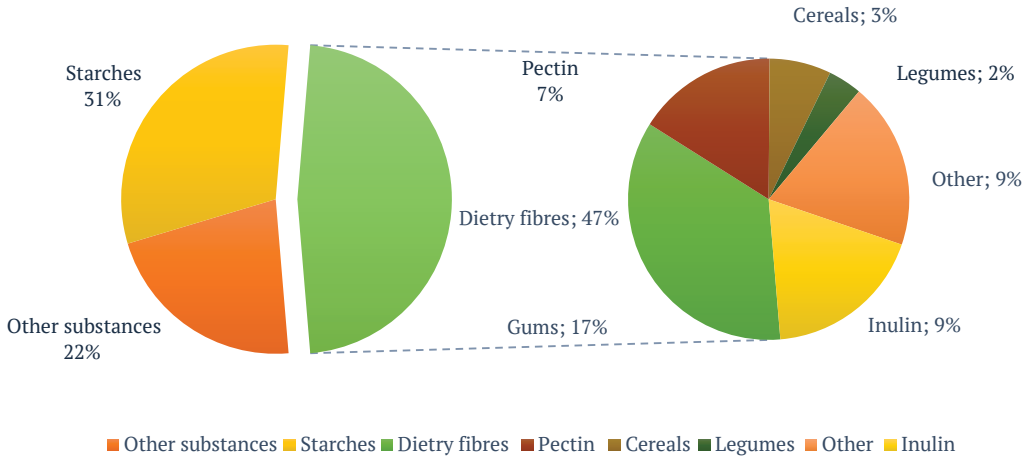

Figure 7. The content of polysaccharides in studies on reducing the caloric content of sausages

Among dietary fibre, gum (17%) and inulin (9%) are the most commonly used. The rest were pectin (7%), dietary fibre from cereals (3%), legumes (2%) and other crops that contain dietary fibre in their structure (9%).

The search for information on the use of inulin-containing raw materials such as chicory, Jerusalem artichoke, artichoke, banana, dahlia in the technology of sausage products did not yield fruitful results.

A total of 64 articles related to the use of inulin in the composition of inulin-containing raw materials in sausage products were found, four of them about sausage with chicory, six – about sausage with Jerusalem artichoke. The article presents statistical data on meat consumption in Ukraine and the world, the distribution of consumer purchasing and taste preferences, and systematises areas for improving the quality of sausages.

Conclusions

Meat and meat product are promising foods for a healthy diet, as they contain valuable biologically active

components – L-carnitine and taurine, which have important functions (antioxidant, hypotensive and immunomodulatory) and are absent in plant products. Over the past 10 years, meat consumption in the world has not been uniform, however, over the past three years, there has been a steady upward trend in consumption of this product.

An analysis of the consumption of meat and meat products in Ukraine in 2011-2021 revealed that over the past decade, the consumption of sausages has been almost stable. Ukrainians consume 70% more sausages compared to other meat products, therefore, due to their popularity among consumers, it is advisable to increase their health properties.

The analysis of consumer preferences shows that among the wide range of sausages on the Ukrainian market, respondents choose boiled sausages due to their versatility, availability and taste.

Monitoring of open access data on the areas of improving the quality of sausages in accordance with modern world requirements showed that most articles were devoted to the correction of fat content and calorie reduction – 36% (8050 publications). Enrichment of sausage products with inulin is not a sufficiently studied area, as only 2% (161 articles) were found by relevant keywords in international databases of scientific publications.

According to the literature review, of 64 articles found on inulin as a raw material component of sausage products, four were about sausage with chicory and six were about sausage with Jerusalem artichoke.

The use of inulin-containing raw materials in the production of sausage products is a promising, but insufficiently studied direction of improving the health properties of this type of product, so it needs wider coverage and more in-depth study.

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Використання інулінвмісної сировини у технології ковбасних виробів

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Анотація. Починаючи з другої половини двадцятого століття зростає популярність та накопичення дослідження різнобічних шляхів поліпшення ковбасних виробів, що спричиняє необхідність систематизувати наявну інформацію, особливо стосовно використання нетрадиційних функціональних компонентів таких, як інулінвмісна сировина. Метою дослідження було проаналізувати ступінь вивчення проблеми і систематизувати наявну інформацію стосовно методів удосконалення якості і підвищення харчової цінності ковбасних виробів, а також з'ясувати перспективність і доцільність застосування інулінвмісної сировини у рецептурі ковбасних виробів для підвищення їх споживчих переваг та поліпшення нутриціологічних характеристик. Застосовано метод метааналізу доказових даних, що базувався на пошуку літературних даних за період 2001–2022 роки з використанням міжнародної наукової платформи Research4Life, де представлені публікації індексовані у Scopus, Web of Science тощо. Використані статистичні дані Організації економічного співробітництва та розвитку, Державної служби статистики України тощо. Усього було знайдено 64 статті, які стосувалися використання інуліну у складі інулінвмісної сировини у ковбасних виробах, чотири з них про ковбасу з цикорієм, шість – про ковбасу з топінамбуром. У статті також представлені статистичні дані споживання м'яса в Україні та світі, розподілу купівельних та смакових переваг споживачів, систематизовано напрямки удосконалення якості ковбас. У результаті проведених досліджень була відмічена невисока тенденція до зростання попиту на м'ясні вироби, з'ясовано, що найперспективнішим, з точки зору покращення оздоровчих якостей, м'ясними виробами є варені ковбаси, оскільки вони користуються найбільшим попитом серед українських споживачів. Найпоширеніші методи удосконалення якості ковбасних виробів – корекція жирності і зниження калорійності. досліджень технології ковбасних виробів з інулінвмісною сировиною. Систематизація та структурування наявного масиву інформації щодо використання інулінвмісної сировини у технології ковбасних виробів полегшить встановленню доцільності та необхідності практичного застосування цього методу поліпшення якості зазначеного сегменту харчових продуктів

Ключові слова: замінники жиру, м'ясні вироби, інулін, цикорій, топінамбур, артишок, органолептика, оздоровчі властивості