FOOD TECHNOLOGY PROGRESSIVE SOLUTIONS

Collective monograph

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CHAPTER 7

Crafting fermented pepper-based hot sauces

Tetiana Kolisnychenko
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Abstract

In today's business environment in the food industry, business entities need to focus on improving and diversifying the range of products and dishes offered on the consumer food market. This requires the development and implementation of innovative technologies in production, focusing not only on the nutritional value of products, but also on their usefulness and compliance with individual consumer needs.

Currently, the creation of a variety of new products to improve the nutritional status of humans is a timely and relevant issue facing food scientists. Food technologies use functional ingredients with enhanced protective and improved technological properties.

The article analyzes the essence of the technology of craft hot sauces, systematizes the theoretical basis and methodological developments on the information base on the technology of production of craft hot sauces for restaurant business enterprises in modern economic conditions. A corresponding analysis of the principles, features and practical experience of craft production of hot sauces is carried out. A comparative analysis of the technology for the production of craft hot sauces by characteristic properties is carried out. Based on the results of the scientific research, the advantages of using innovative technologies for the production of hot sauces in craft production are determined. The importance of taking into account changes in tastes and consumer priorities in the nutrition of visitors to restaurant establishments is emphasized.

Comprehensive studies allow to state with confidence that the use of available vegetable raw materials and raw materials with high nutritional value allows expanding the range of craft sauces for restaurant business enterprises.

It is proved that when creating new compositions of hot sauces to ensure the guarantee of their production with the necessary structural, mechanical and organoleptic properties, the choice and justification of the use of natural resource raw materials for the recipe ingredients, their rational combination are taken into account.

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Craft production, restaurant, hot pepper, fermentation, biological value, functional properties, organoleptic indicators.

7.1 Introduction

In the food industry, business entities face the issue of improving and diversifying the products and dishes offered on the consumer market, which requires the need to develop and implement innovative technologies, focus not only on their nutritional value, but also on their usefulness and individualization of demand. In the modern world, where the pace of life is rapidly increasing, and the daily rhythm becomes more stressful, sauces have become an integral part of culinary culture. Considering the globalization of culinary preferences, exotic flavors and non-traditional seasonings are increasingly found in sauces. These products have numerous advantages and simplify the cooking process, making it more efficient and convenient. Sauces allow for a wide range of flavors and aromas in culinary use. With their diverse palette of tastes, they can be successfully used to prepare various dishes, from classic to exotic. Most importantly, sauces can be a beneficial addition to a balanced diet and have functional properties. The richness of vitamins, minerals, and antioxidants in some of them makes these products not only tasty but also beneficial for health. Including plant-based ingredients in their composition can help combat hidden hunger, providing the body with necessary phytonutrients [1]. Additionally, sauces have high added value, and their production is quite profitable. The results of market research have confirmed the need for the creation of new types of food products made using only natural ingredients as stabilizers and flavorings [2]. The combination of high-quality raw materials will make it possible to produce a product with a balanced composition of nutrients.

This, for the most part, necessitates planning production processes with due regard to a set of optimization measures – economic, financial, organizational, technological, environmental, etc. In a competitive environment, a vivid example of adaptation to the conditions of uncertainty, risk and crisis is the activity of restaurants. For effective operation, they must find their unique product proposition in the consumer market, which involves not only organizing customer service processes, service, but also expanding the range at optimal costs without sacrificing quality.

An example is the use of a palette of sauces for various dishes. Sauce is an additional component with a liquid or semi-liquid consistency that is used in the cooking process or served with the finished dish to improve the taste and flavor. In modern cuisine, they are an integral part of a wide range of hot and cold dishes, appetizers, desserts, etc. [3].

Sauces can be classified according to various criteria, including geographic origin (for example, Italian, Indian, Japanese sauces, etc.), serving temperature (for example, hot or cold sauces), flavor (for example, mild or spicy sauces), acidity (for example, low-acidity sauces or acidic ones), sweetness (for example, sweet or savory sauces), color (for example, brown sauces, pink sauces, green sauces, etc.) [4]. Different condiments with varying sensory profiles are preferred and regularly consumed by people of different ethnic groups in different countries. Soy sauce is the leading condiment in Asian markets, with up to 5,876,000, 856,000, and 420,000 metric tons used annually in China, Japan, and Indonesia, respectively. This compares to some 679,600 metric tons of ketchup that was consumed in the United States in 2013, and approximately 333,000, 285,000, and 37,000 metric tons of fish sauce consumed in Vietnam, Thailand, and Myanmar, respectively [5]. Over the past 5–10 years, sauces made using the so-called "craft" method have become particularly popular, due to the growth of private family-owned small businesses and farms, where, in particular, it is possible to carry out a full range of production processes – "from field to table". Craft production differs from mass industrial production, first of all, in that production is carried out without the use of its characteristic technologies and at low capacity, i.e. it refers to small enterprises. Craft producers can manufacture products in small batches and cater to both traditional and exotic consumer tastes. Hot and spicy sauces are an integral part of the traditional cuisine in Asian, South American, and American countries. For most European consumers, hot sauces are considered exotic and are consumed in small quantities.

The number of consumers who focus on and show increased interest in the chemical composition, nutritional value, and presence of functional ingredients in food products is rapidly growing. This is driven by the issue of unbalanced nutrition due to the consumption of refined, processed foods, at a time when a healthy diet requires saturation with dietary fibers, vitamins, micronutrients, minerals, unsaturated fatty acids, etc. Taking into account the growing interest in healthy eating, the consumer food market is in need of products with increased nutritional value, enriched with biologically active components and excellent organoleptic characteristics. This effect can be achieved through the use of non-traditional plant raw materials in the production technology.

The production of food products with improved chemical composition and increased content of bioactive substances is one of the most pressing issues. This problem can be solved through the development and use of food technologies that combine different types of raw materials, which will ensure high quality of the finished product.

As practice shows, the sauces that meet the criteria of enhanced nutritional value positioned as "healthy food" or possess functional properties are the most popular. Therefore, expanding the range of craft sauces with increased nutritional value for HORECA sector enterprises is a relevant task.

7.2 Requirements for the production of craft sauces

The concept of "craft sauce" is associated with such definitions as uniqueness of recipe, use of natural ingredients, and application of technologies that allow for maximum preservation of freshness and flavor of quality components of the product.

If to analyze the norms and requirements for the design and recipe of craft products and dishes, it is worth noting the absence of strict requirements for their production technology. The main principle, as mentioned above, should be, as a result of predominantly manual and family labor at all stages of the production process, a guarantee of the absence of artificial preservatives, colorants, food additives and chemical ingredients. However, this is not a reason for craft producers to ignore the need to obtain relevant certificates and meet sanitary requirements. Thus, in order to sell craft products, entrepreneurs must have all the certificates of health safety required by the current legislation of the country where the craft food is produced. In fact, each craft product has a unique recipe, which determines the high quality of such a unique product. It is worth noting that the technology of manufacturing craft products involves careful quality control of the selection of all components without exception and their combination based on a unique recipe. In this case, the manufacturer's skill is of great importance. Practice proves the uniqueness of a craft product throughout the entire cycle – from growing or purchasing the right kind of natural ingredients (raw materials) from producers to selling it to the consumer in its original packaging, where attention should be focused on the uniqueness and natural ingredients and the environmental orientation of the technology of both product production and packaging.

In fact, there is currently no legislatively defined concept of "craft production" in Ukraine, which, given the national nature of production, requires compliance with certain criteria, including the predominance of manual labor rather than mechanized labor; only high-quality raw materials are used. The philosophy of a craft product is based on responsibility to the consumer, the desire to match the general culture of consumption with the indicator of quality and significance. At present, there are no legislatively defined requirements for the area, volume, and capacity of craft production in Ukraine, i.e. it can be either small or large-scale production. The only exceptions are restrictions on those industries that require a certain type of license permit, which is granted separately for the manufacture of the product and for the sale, for example, beer from a craft brewery. With regard to the differences between mass production and craft production, it is advisable to take into account the experimental nature of such production, driven by the desire

to achieve the highest, sometimes original taste, which affects pricing and requires intensifying the search for its own consumers and taking into account changing tastes. For such activities as "artisanal", which relate to the smallest producers and family food producers, favorable conditions are created to attract donors, financial support for the development of family businesses and the development of rural communities.

However, sanitary regulations apply to enterprises involved in food production, regardless of ownership form and departmental subordination, and must be fully complied with. A threat to food safety may be posed by a biological, chemical or physical agent in food that may cause adverse health effects. Food safety is ensured by the joint efforts of all participants in the food chain.

Culinary products are produced in the form of dishes, culinary products and culinary semi-finished products that differ in their main characteristics (**Fig. 7.1**).

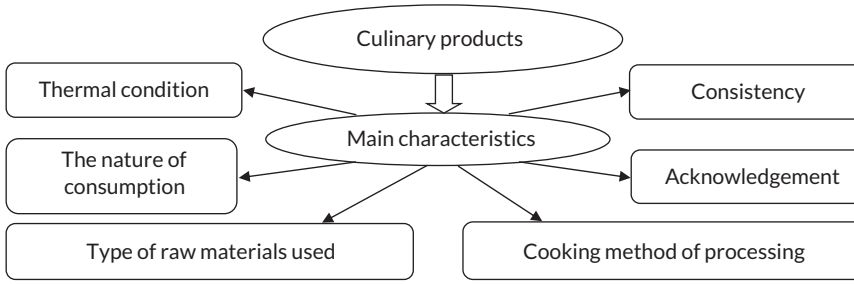

Fig. 7.1 Main characteristics of culinary products

Hygienic standards for microbiological indicators include control over four groups of microorganisms: sanitary indicators, potentially pathogenic microorganisms, pathogenic microorganisms, and microorganisms that cause product spoilage [6]. Microbiological standards also apply to products of intensive technologies: using microwave and infrared heating, as well as to products made from fermented raw materials, which is of interest and important when applying the technology of hot sauce production. Regarding compliance with microbiological standards for sauces or dressings for second courses produced by catering companies for garnishes, here are examples. In particular, the total number of mesophilic aerobic and facultative anaerobic microorganisms CFU should not exceed 3.5·10 in 1 g/cm^3; the mass of the product in which BCCP (coliforms) is not allowed is 1.0 g/cm^3; the mass of the product in which *E.coli* is not allowed is 0.1 g/cm^3; the mass of the product in which *S.aureus* is not allowed is 5 g/cm^3 [6].

7.3 Assortment and ingredients of hot sauces

There are many variations and names of hot sauces. In fact, every culture has its own original sauces, including spicy ones, as natural ingredients for them are mostly grown within the territory of a particular country and are characteristic of that country, corresponding to its culinary traditions. Even within one country, seemingly similar sauces differ in ingredients, their proportions, and technological features. Currently, in Ukraine, hot sauces from craft producers have their own differences not only due to natural raw materials, but also due to the manufacturing technology. The advantage of hot sauces is their inherent ability not only to enrich the taste of dishes, but also to create new dishes based on hot sauce, thereby creating conditions for expanding menu offerings.

In such European countries as those located in the north and east, hot sauces are popular as a seasoning for almost all types of meat, fish, poultry, vegetables and are popular in Germany, Alsace, many countries of Central and Eastern Europe, etc. In England, for example, hot sauces are used to enrich the flavors of roast beef and in the United States, fast food restaurants use hot sauces.

Ukrainians, according to their culinary preferences, tend to lean towards European cuisine. Therefore, hot and spicy sauces are used here significantly less than in Asian or American cuisine. Traditionally, spicy sauces made from the seeds of plants such as white mustard (*Sinapis alba*), brown mustard (*Brassica juncea*), black mustard (*Brassica nigra*), and horseradish root (*Armoracia rusticana*) are widely popular.

Mustard seed is good source of protein, fiber, minerals, vitamins, antioxidants, and phytonutrients. In addition, mustard is a source of valuable phytonutrients. Its main biologically active components are glucosinolates (sinigrin and sinalbin) and their breakdown products, rich in sulfur-containing isothiocyanates, phenolic compounds, and phytosterols. These compounds possess antioxidant, anti-inflammatory, anticancer, antimicrobial properties [7].

Mustard is a condiment sauce made from ground, often de-fatted mustard seeds, mixed into a paste with water, vinegar, salt, oil, and other spices, and then refined. By using different varieties of seeds and adjusting the concentrations of the main ingredient, milder or spicier sauces are obtained.

Horseradish or Armoracia rusticana is a perennial herbaceous plant in the Brassicaceae family, which also includes mustard, wasabi (sometimes called Japanese horseradish), cabbage, and broccoli. Horseradish is a popular culinary addition due to its ability to enhance the flavors of dishes and sauces, as well as its functional properties. In recent years, scientists have been paying increasing attention to horseradish due to its high content of biologically active compounds. The specificity of these

compounds gives horseradish antioxidant, antibacterial, fungicidal, and anti-tumor properties [8]. Like in mustard, the sharp, pungent taste of horseradish is attributed to glucosinolates. In addition to glucosinolates, horseradish contains many other antioxidants, some of which not only destroy and block free radicals, but also prevent the appearance of mutations that can occur in humans under the influence of adverse environmental conditions and side effects from taking medications, which in turn can increase the likelihood of developing various degenerative diseases [8]. In Ukraine, a moderately spicy snack called "Buriachky" of grated boiled beetroot, mixed with chopped fresh horseradish root, vinegar, sugar and salt, is traditionally cooked. A popular addition to meat dishes in Eastern Ukraine is grated horseradish mixed with thick cream. A traditional "Horseradish and Beetroot" spicy seasoning is produced on an industrial scale, where crashed horseradish roots are mixed with raw beetroot.

Many hot sauces are based on peppers (*Capsicum spp.*). The most common is considered to be chili sauce. Chili sauce is a condiment prepared from the edible portion of healthy and clean fresh chili peppers or processed chili, such as chili that has been roasted into powder, chopped, or pickled in vinegar or other acid. It may also contain mango, papaya, tamarind, tomatoes, garlic, onions, carrots, sweet potatoes, other spices and herbs, honey, and other edible ingredients [9].

Peppers are commonly considered vegetables, but from a botanical perspective, they are berries. Pepper varieties are classified based on the characteristics of their fruits, such as spiciness, color, fruit shape, as well as their usage. When ripe pods of red peppers are dried and ground, they become the most consumed spice in the world. Practically all pepper varieties cultivated for commercial purposes in the USA belong to the species Capsicum annum. However, one main type, "Tabasco", belongs to Capsicum frutescens. Two other pepper species gaining popularity are Capsicum chinense, "Habanero" and "Rocotillo", and Capsicum pubescens, "Peron" and "Manzano" [10].

Hot pepper is the only plant crop that contains capsaicin. Recent scientific studies have shown that capsaicin contained in hot peppers has antimutagenic and antitumor effects [11]. This component inhibits the growth of cancer cells, which confirms its effectiveness. The presence of this substance determines the beneficial properties of the product. According to research, the alkaloid capsaicin has a pronounced anti-inflammatory, analgesic and antioxidant effect. In addition, hot peppers help prevent oxidative stress, protecting cells from damage and keeping them young. Pepper contains vitamins B_1, B_2, A, E, C, P, as well as various trace elements that are essential for the normal functioning of the body, such as calcium, iron, phosphorus and silicon.

Hot pepper has beneficial properties because it acts as a natural preservative. Its complex components have antimicrobial and antibacterial effects that prevent the development of harmful microorganisms in foods.

As an example of research aimed at determining the antioxidant properties of certain plant species, it is advisable to consider the results of the study of Iranian chili pepper extract, for which some solvents, such as water, ethanol, and a water-ethanol solution, were used [12]. Two types of tools were used to influence the object of study, including with and without treatment with ultrasonic waves. The amount of tocopherol and phenolic compounds in the extracts was measured by the stoichiometric method, and the antioxidant capacity of the extracts was measured and analyzed using beta-carotene and DPPH tests. As a result, the oxidative stability of the extracts was determined. The data were statistically analyzed using analysis of variance (ANOVA) and Duncan's test. The level of $P<0.05$ was considered statistically significant. The maximum and minimum extraction efficiencies of phenol and tocopherol compounds were obtained using ethanol and water, respectively. Thus, due to its high antioxidant capacity, hot peppers can be widely used in the food industry.

The technology for preparing a special premium group of hot sauces involves the use of a pepper fermentation process. Sauces have a consistency from liquid to pasty, and can be moderately or extra hot. Also, hot sauces can differ in color – green, red, brown.

Among the variety of hot sauce formulations, in Ukraine, hot sauces based on peppers, such as "Chili", "Habanero", and "Trinidad Scorpion", are widely popular among consumers' taste preferences.

When we use the term "hot" sauce, we associatively understand that it refers to a certain degree of hotness. Nowadays, this hotness is given to hot sauces by the spicy ingredient capsaicin, which, when added to liquid and paste-like mixtures, contributes to the creation of the original flavor. Thanks to this spice, any dish can deepen its flavor.

Today, one of the most well-known hot sauce companies is Tabasco, which was actually the first to start packaging hot sauce in bottles. Among the well-known suppliers of hot sauces for HORECA are, in particular, those that offer exotic or author's hot sauces based on Scorpion Trinidad with BBQ and Habanero. Technologists and culinary specialists also offer new author's hot sauces, including, for example, the hot sauce Zapal Horeca, which is in demand among restaurateurs. There is also a constant demand for modernization of classic recipes in the restaurant industry. Especially popular in the world are recipes based on fruits, including pineapple, mango with the addition of habanero or chili peppers. However, it is worth noting a certain difference in the flavor properties of hot sauces depending on the region of their origin.

For a more detailed consideration of the features of hot sauce production technology, it is worth paying attention to the essence of the system that measures the

level of capsaicinoids in a particular substance. We are talking about spicy chemicals, not just capsaicin in a substance. This system is called the Scoville Scale in honor of the pharmacist Wilber Scoville, who developed this indicator in 1912, measured in Scoville Heat Units (SHU) and used to assess the spiciness of a particular dish. If this indicator is determined in a hot sauce, this system allows to find out the level of its burning sensation. Thus, if during a standard tasting there is a certain subjectivity in determining the hotness of a hot sauce, then by measuring chemicals on the Scoville scale, it is possible to obtain an objective result.

7.4 Features of the technology and organoleptic characteristics of hot craft sauces

Even during the COVID-19 quarantine and amid the war in Ukraine, the niche of craft food products and dishes based on natural ingredients and using environmentally friendly technologies continued to be enriched with new offers. Among other things, the range of craft hot pepper sauces is constantly expanding.

Pepper is one of the most profitable products for processing, as with the right approach, only the stem remains from the waste. The pepper itself goes into the sauce, and from the pomace, oil or spices can be made. The original processing and production technology of hot sauces was developed using fermentation methods, similar to how it was done in ancient times to preserve products, or made based on fermented peppers, i.e., those fermented in oak barrels.

The technology of making hot sauces requires taking into account all stages from preparation to growing plants to final production and packaging. Issues such as the method of growing peppers in heated greenhouses or two- to three-year storage of plants, measures to avoid over-pollination, fruit change processes, pungency and taste for the following years are addressed. Experiments are being conducted with different varieties, their yields and growing technology. In order to avoid cross-pollination, no more than 12–17 varieties of pepper are selected from at least 40–50 varieties of pepper for further use in the production of hot sauces based on the results of greenhouse experiments. In addition to the requirements for agro-technological issues, the technology for processing the pepper harvest and making sauces is also unique. The company uses its own development, cold fermentation, which makes it possible to produce the final product without preservatives. In fact, the company has developed a technology that "allowed it to avoid large-scale capital expenditures" and has proven to be effective. To produce a hot sauce of appropriate pungency and flavor, a number of requirements must be met. For example, peppers should not be watered

two weeks before harvesting, as this affects the pungency, which will increase due to the low amount of moisture. Pepper seeds are also a very important component.

The technology of making hot sauces by cold fermentation allows to produce the final product without preservatives and is unique, although its development requires too much time to determine the optimal mode. Fermentation during the experiments was carried out in both large and small metal containers. The search was made to ensure sufficiently moistened wort and to protect it from oxygen. An important aspect of developing the technology for the production of craft hot sauces was that it was necessary to develop a technology that would avoid large-scale capital expenditures and be effective at the same time.

For the production of hot sauces, the fermentation method is used, similar to the process of creating red wine, which allows to avoid oxidation of flavoring substances and preserve their bouquet in the finished product. The peculiarity of fermentation is that this process can also occur without the participation of microorganisms. In this case, fermentation occurs exclusively due to the tissue's own enzymes, which are subject to such treatment, and the fermentation process takes place on the cut, i.e., in the presence of air oxygen, polyphenol oxidases oxidize polyphenols and quinones are formed. In turn, quinones oxidize amino acids and as a result, melanin, a brown pigment, is formed.

It is important to distinguish the fermentation process from the process of industrial cultivation of microorganisms in bioreactors to produce a variety of valuable products, from biofuels to animal protein substitutes and antibodies. There is also a difference between the fermentation process and the technology of using enzymes isolated from microorganisms to break down complex molecules, i.e., the method of enzymatic hydrolysis.

And although craft producers today emphasize the innovation of the fermentation technology for the production of hot sauces, it is fair to say that this method was actually used in one form or another by our distant ancestors. Today, fermented foods are back in the spotlight, mainly because of the positive health effects of fermented foods. In practice, fermentation is a unique biotechnological process that not only helps to preserve food and beverages for a long time, but also helps to significantly increase the nutritional value of products and create fundamentally new ones. As for the classification of fermented products, they are distinguished according to the type of raw materials and the methods of biochemical transformation of substances. Experiments have proven that different microorganisms are involved in the formation of all fermented products, where each species has its own role and result of its activity. It is worth noting that the majority of fruits, vegetables, cereals, and dairy products are fermented by the first type of fermentation, i.e. when lactic

acid fermentation accumulates organic acids, which lead to a decrease in pH and the appearance of an acidic taste, as well as change the texture of the product and can increase its nutritional value. It is important to realize that in this case, the human body absorbs these fermentation products better due to the increased solubility of mineral elements [13].

Most traditional fermented foods are characterized by a complex combination of the vital processes of various microorganisms. Almost all vegetables and their mixtures contain sugars, which are used in the fermentation process. Among the most popular vegetables for fermentation are cabbage, cucumbers, and olives. In fact, all parts of the plant are a natural environment for a wide variety of microorganisms, including bacteria, yeast, and molds. Due to the contact of plant surfaces with atmospheric air, it is almost impossible to avoid the appearance of aerobic bacteria, fungi and facultative anaerobes that can exist both in the presence of oxygen and in its absence. On plants, lactic acid bacteria, which are anaerobes and therefore die from oxygen, may be present in small quantities.

The process of lactic acid fermentation is characterized by the following features: after a number of bacteria that grow differently in the fermentation medium for a certain period of time have undergone the process of fermentation, their growth is inhibited or stopped due to the accumulation of metabolic products; then another group of bacteria develops in the anaerobic environment. If anaerobic conditions are not maintained, i.e., there is access to atmospheric air, aerobic bacteria and fungi begin to develop to replace lactic acid bacteria, which causes rotting and mold formation.

When making pepper sauce, the fruits are first processed into a homogeneous mass, then a few hours later, the process of lactic acid fermentation takes place, which can last from one to several weeks. While there is still some oxygen in the pepper wort tank, facultative anaerobes dominate among the bacteria, but after 1–2 days in the absence of oxygen, lactic acid bacteria begin to prevail, which promotes the fermentation of sugars to lactic acid to produce a small amount of acetic acid and ethyl alcohol. At this stage of the fermentation process, intense carbon dioxide is released. Additional fermentation substrate can be created by the synthesis of enzymes by some bacteria. The resulting enzymes break down cell wall polysaccharides, including hemicelluloses, starch, pectins, and cellulose. As a result of the fermentation processes, which are quite complex, a significant amount of byproducts is recorded, including alcohols and organic acids, which, in turn, enter into an esterification reaction to form esters, volatile compounds with a pleasant odor. These processes contribute to the formation of new flavors in the fermented sauce, which distinguishes it from the smell of fresh pepper.

Also, due to the release of compounds contained in fresh pepper fruits, a unique bouquet of smells and flavors is formed in the sauce wort, i.e., the taste and aroma properties of the product are improved. At the same time, these substances inhibit the growth of yeast. As a result of the accumulation of acid in the sauce wort, its pH drops to 4.5, and the fermentation rate slows down. This is because under such conditions, only acid-resistant bacteria survive, which causes the fermentation of the remaining sugars. The fermentation process is eventually completed when the pH level is fixed at about 3.4. As a result, the growth of the vast majority of microorganisms is inhibited, which contributes to the increase of the shelf life of such wort in the absence of air access [14]. Thus, fermented hot sauce is rightly considered a unique product, the taste and pungency of which is influenced not only by the pepper fruit, but also by strains of bacteria and microorganisms that affect the fermentation process [15].

At the same time, the issue of intensifying the development of new recipes and technologies for culinary products for healthy eating, including sauces, remains insufficiently addressed.

Currently, Ukrainian scientists have proposed a number of scientific approaches to develop new types of sauces with the addition of functional ingredients. Ukrainian scientists continue to work on developing recipes for sauces with soluble dietary fiber, which helps to bind and remove anthropogenic pollutants and products of metabolic disorders from the body. The main condition for obtaining a high-quality sauce product should be to obtain a stable and uniform consistency that would protect against delamination when serving the sauce to the consumer, i.e., its viscosity is ensured [16]. When it comes to the appearance of sauces, in the HORECA sector, it's important to consider its significant impact on both the physiological and psychological perception of consumers. The sauce should be homogeneous in appearance, without films and fatty substances on the surface [16].

In recent years, foreign scientists have also obtained a number of positive results in developing new technologies for the production of sauces, including the study of the introduction of okra in natural and lyophilized forms into tomato sauce as a thickener and emulsifier of mucus; the proposed technology of natural sauce made from processed cheese flavored with essential oils; the development of a technology for enriching white sauces with red bell pepper and the determination of the sensory characteristics and consumer acceptability of new white sauces [17].

A rational recipe composition was experimentally selected and the production technology and assortment of craft hot sauces were developed (**Fig. 7.2**). The sauces are either made by salting, as was done in ancient times to preserve food, or made on the basis of fermented peppers, i.e. fermented in oak casks, with the addition of quince, pear and honey.

Fig. 7.2 Spicy craft sauces

The main factors that determine the state of human health are food safety and quality. Therefore, any development of food technology should include the study of these indicators. Usually, organoleptic properties are the first among the quality indicators to be studied. Sensory analysis allows to establish the patterns of formation of organoleptic indicators, since these are the indicators by which potential consumers primarily evaluate the product.

Assessing the quality of food products using the human senses is the oldest and most common method. Modern laboratory methods of analysis are more complex and require more effort compared to organoleptic evaluation, but they allow characterizing certain quality attributes. Organoleptic methods are fast, objective and reliable for the overall assessment of product quality. Sensory control allows to quickly and purposefully influence all stages of food production.

The developed hot sauces were subjected to an organoleptic analysis, which is important for food manufacturers, as it allows them to quickly assess the quality of not only finished products but also products at different stages of production. Identification of defects and shortcomings of semi-finished products allows timely correction of technological violations and prevention of low-quality finished products (**Table 7.1**).

According to the analysis presented in **Table 7.1**, it can be concluded that the developed spicy craft sauces have high taste quality, which will positively affect the perception of the new product.

During the research, a quality assessment system for hot sauces based on fermented peppers was developed, taking into account the importance of each criterion (**Table 7.2**), which allowed to demonstrate high organoleptic quality indicators of the products.

Table 7.1 Organoleptic characteristics of concentrated craft hot sauces

Name of indicators	Sauces names	
	Habanero sauce	Habanero sauce (pear, honey)
Appearance	Homogeneous, evenly mashed puree-like mass that does not spread on a horizontal surface	Homogeneous, evenly mashed puree-like mass that does not spread on a horizontal surface
Consistency	Homogeneous, without foreign inclusions	Homogeneous, without foreign inclusions
Color	Light yellow	Light yellow
Odor	With a pronounced flavor of pepper and quince	With a pronounced flavor of pepper, pear and honey
Taste	Spicy-sour-sweet with a pronounced quince aftertaste	Spicy-sour-sweet, with a pronounced pear and honey aftertaste

Table 7.2 Results of organoleptic analysis of craft hot sauces

Name of indicators	Weighting factor	Characteristic weighting factor	Features	Evaluation, points	
				Habanero sauce	Habanero sauce (pear, honey)
1	2	3	4	5	6
Appearance	0.2	0.83	Homogeneity	4.80	4.80
		0.17	Absence of inclusions	4.70	4.80
	Total score by indicator			**0.95**	**0.96**
Consistency	0.25	0.4	Homogeneity	4.80	4.90
		0.3	Density	4.70	4.70
		0.3	Fluidity	4.90	4.90
	Total score by indicator			**1.19**	**1.20**
Color	0.15	0.3	Intensity	4.70	4.90
		0.2	Expression	4.90	5.00
		0.2	Homogeneity	5.00	5.00
		0.3	Naturalness	5.00	4.80
	Total score by indicator			**0.74**	**0.74**
Taste	0.25	0.1	Balance	5.00	4.90
		0.2	Expressiveness	5.00	4.80
		0.1	Speed of release	5.00	5.00
		0.3	Naturalness	4.90	5.00
		0.3	Purity	4.90	5.00
	Total score by indicator			**1.24**	**1.24**

Continuation of Table 7.2

1	2	3	4	5	6
Odor	0.15	0.3	Purity	5.00	5.00
		0.2	Expressiveness	4.90	5.00
		0.2	Stability	4.90	4.90
		0.3	Compliance with the type of raw materials used	5.00	4.90
		Total score by indicator		**0.74**	**0.74**
		Overall assessment		**4.86**	**4.88**

The results of the tasting evaluation show an unambiguously positive response to the developed food product. The profiles of organoleptic quality assessment of hot craft sauces are shown in **Fig. 7.3**, **7.4**.

During the organoleptic analysis, it is found that the obtained sauces have high quality indicators in terms of organoleptic characteristics. The system of scoring the quality of sauces, taking into account the importance coefficient, shows that the overall score for sauces is as follows: for Habanero craft hot sauce – 4.86, for Habanero craft hot sauce (pear, honey) – 4.88. The developed craft sauces have a traditional taste that is positively perceived by consumers, which will contribute to the success of the innovative product.

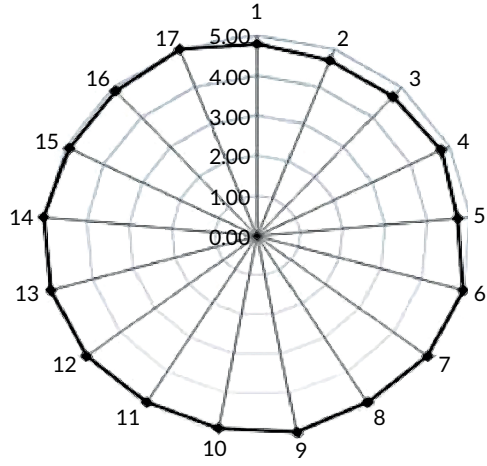

Fig. 7.3 Organoleptic profile of Habanero craft hot sauce

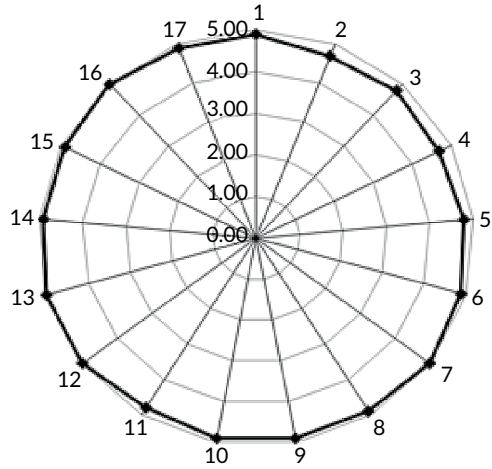

Fig. 7.4 Organoleptic profile of Habanero craft hot sauce (pear, honey)

Conclusions

Thus, even during times of war, the production of certain products in small batches with the processing of local raw materials by farmers and the manufacture of craft products based on it makes it possible to develop mini-enterprises in the food industry. These enterprises can operate during a state of war, require minimal capital investment, have a better understanding of the dynamics of the regional market, and take into account all aspects of the population's food needs.

In cooperation with research scientists and taking into account consumer demand, the fluctuations of which should be studied, it is possible to achieve positive results in the food industry and restaurant business. Among the various technologies for the production of hot sauces, including at craft enterprises, it is currently advisable to highlight the importance of fermentation technology as one that contributes to the creation of products with increased nutritional value and unique properties and health benefits. It is recommended to pay special attention to the cold fermentation technology, which is used in Ukraine to produce hot sauces directly at craft enterprises.

Given the wide range of topical areas of research, to reveal the essence of the stated topic, the results of monitoring the state and processes and technology of developing hot sauces at small businesses, in particular family-type enterprises

operating in Ukraine, are mainly presented. The author also analyzes the current regulatory framework in Ukraine on the production of sauces, the organization and features of craft food production, the principles of operation of restaurant business enterprises in the current business environment and their motivating factors for using hot sauces in their production activities. It is proved that when creating new compositions of hot sauces to ensure the guarantee of their production with the necessary organoleptic properties, it is important to take into account the choice and justification of natural resource raw materials for the recipe ingredients, their rational combination.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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