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## TECHNOLOGICAL AND COMMODITY SCIENCE ASPECTS OF INCREASING THE COMPETITIVENESS OF GEL DRINKS WITH AN "ANTI-AGE" EFFECT

The purpose of the article is to describe the practical aspects of identifying gel drinks based on collagen to identify signs of their possible falsification. The article analyzes technological aspects and influencing factors on the formation of quality indicators and consumer properties of collagen-based gel drinks. The main organoleptic characteristics of the quality and attractiveness of new types of health drinks based on collagen are also considered. Attention is focused on methods of checking and achieving a high quality level of input raw materials and additional components. The production technology in industrial conditions is presented by analyzing the stages and technological process and the stages of preparation of recipe components for their participation in the technological process. Also considered are practical recommendations for the qualitative identification of gel drinks in order to detect adulterated products containing gelling agents of a non-protein nature. In Ukraine, gel drinks are only gaining popularity, but collagen-based drinks in the form of shots are a novelty for the domestic beverage market, as they mostly belong to the "beauty" industry and sports and fitness nutrition. Today, collagen drinks are presented either in the form of dry drinks (fast-dissolving form) or foreign production. In connection with the reduced solvency of ordinary Ukrainian citizens and the course of the Ukrainian government on import substitution, the presented development is predicted not only to gain popularity among supporters of a healthy lifestyle, but also to take a leading position in the near future among those who seek to postpone the signs of aging or prevent premature aging. The contingent of such consumers will grow every year, because the issue of prolonging youth is no longer a matter of time, but of modernity, since the increase in the retirement age requires the working population to be active and energetic, smooth and speed of movements, intensity of brain activity and long-term concentration of attention for at least 15-20 years more than was necessary even 5 years ago. Therefore, it is extremely important to prevent the actions of unscrupulous manufacturers who will look for ways to reduce the cost of gel drinks based on collagen, replacing the main component with polysaccharide gelling agents, which provide a similar consistency with a small content, but at the same time do not have the healing effect that collagen has for the human body. The article outlines aspects of the identification of collagen-based gel drinks; the need for their identification to identify possible signs of falsification is substantiated, methods for performing such studies are given.

**Key words:** commodity science, gel drinks, anti-age effect, technologies, organization of production.

### Introduction.

The volume of the global collagen market in 2020 was estimated at almost 8.5 billion USD and according to the compound annual growth rate (CAGR) it is expected to grow until 2028. On the one hand, such growth will be stimulated by the cosmetic industry, in particular the "beauty" industry, on the other hand the growth by the food and dietary supplements market for athletes, fitness users and supporters of a healthy diet and lifestyle.

Collagen-based products have already found wide use in the beauty and health industries. Also, these products have become indispensable for athletes and soldiers, but they are especially necessary for those who follow "anti-aging" practices.

In the form of drinks, collagen is not widespread enough in the countries of Europe, especially in the East. However, the market of beauty and beauty products in these countries is replenished by Korean, Japanese, and French brands. It is expected that the production of beverages with specific healing properties and rejuvenating effects will make the main contribution to the increase in demand for domestic gelatin and hydrolyzed collagen (animal, fish), since these products are indispensable proteins for the human body and have numerous advantages and recommendations for their consumption for improvement condition of the skin, hair, joints, retina. However, there are occasional concerns among consumers about the health status of animals before they become a source of gelatin and collagen. Such concerns are not unfounded, because there are producers who, for the sake of profit, sell raw materials from animals that have suffered diseases. However, it should be noted that we are not talking about domestic producers of gelatin and collagen. In the domestic market, everything is quite controlled and calm in this matter. This product is regulated by laws and regulations on raw materials and ingredients of animal origin used in

the production of collagen and gelatin. The demand for the finished product (collagen-based drinks) is expected to grow on the back of changing consumer preferences and lifestyles, increasing awareness of key health benefits and personal hygiene. The European Parliament played an important role in creating the specifications and requirements specified in the regulations, for manufacturers first and for distributors and consumers second and third. Compliance with these specifications and requirements will allow to receive, sell and consume high-quality and safe products, because each batch is tested for the main indicators of quality and safety [1]. Specifications related to the procurement and testing of raw materials of animal origin for human consumption can make the process of purchasing raw materials somewhat cumbersome and complicate the production process, but such actions are forced and aimed at the prospect of completely ridding the market of dishonest players.

Regarding raw materials, it should be noted that cattle, pork, poultry and marine fish are the four main sources of collagen. In 2020, collagen from bovine sources accounted for a significant share of nearly 40.0% due to the easy availability of bovine-based raw materials and relatively lower prices than porcine and marine (fish) collagen. But the production of marine collagen is expected to grow at a CAGR of up to 2028. First of all, this is due to the fact that collagen drinks will become popular among Muslim countries and in India, secondly, marine collagen has a more accessible molecular structure for hydration, and therefore has a higher bioavailability. However, today, the price of marine collagen is much higher than that of its animal counterpart.

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Hydrolyzed collagen is known to be absorbed better than non-hydrolyzed collagen [2]. Therefore, the use of hydrolyzed collagen in collagen drinks is promising. The food and beverage segment for anti-aging effects (movement restriction, wrinkles) is expected to grow, driven by demand for similar products in North America and Europe.

#### **Analysis of literature data and problem statement.**

Gel drinks gained recognition back in 2017. At that time, energy drinks for sprinters, long-distance runners and marathoners became successful products in terms of sales [3]. The gel is more convenient to use during exercise than the drink. In addition, the gel-like consistency of the finished product is perceived by the body as food and allows you to increase endurance, which is useful not only during training or competitions, but also during military training and actions [4].

The gel-like consistency is formed due to the hydration of biopolymer fibers (proteins and polysaccharides), which turn into a spatially structured grid (matrix) and have the ability to retain (immobilize) biologically active substances (bioflavonoids, vitamins, etc.), which act as activators of metabolic processes [5]. The activators immobilized in this way are chemically inert to each other, and due to the compacted environment they are also immobile, but due to the presence of water they are activated. Such a commercial form of drinks, such as a gel, allows you to place in one packaging unit a sufficiently large amount of useful ingredients, including insoluble or slightly soluble ones, which by weight can reach up to 25% of the total weight of the portion, which is a strong enough argument in favor of purchasing such product offers, because only water-soluble substances with a total content of up to 5-7% can be placed in the drink, otherwise sedimentation may occur (the formation of sediment or settling of insoluble or poorly soluble particles).

In this sense, the number of portions of drinks must be increased, but drinks with such concentrations of added substances are not perceived by the body as water and do not fulfill the tasks of replenishing moisture reserves in the body and are not included in the structure of cells and the intercellular matrix, therefore the restoration of turgor and thirst does not occur. Gel drinks are perceived as solid food and are digested by appropriate processes. At the same time, the water released from the gel, in case of its collapse when the pH changes in the gastrointestinal tract, has a proven ability to moisturize cells and organelles.

It is necessary to pay attention to the labeling of liquid and gel drinks. At the same time, it is important to note that according to the charging order, brands cannot report ingredients with a Nutritional Reference Value (NRV) below 15%! As a result, many brands provide nutritional information based on 100g of product, rather than 1 serving of gel, which can be between 25 and 100g. With a 100g comparison base, the information appears to be in line with the guidelines.

Weider in Jelly - one of the first gel drinks in the world was first released in Japan in 1994 and had recommendations for consumption by those who are fond of sports. At that time, a special package was already developed for it in the form of a bag with a spout for ease of use, which also increased convenience in transportability. The thick consistency even made it possible to replace a healthy snack or even breakfast and replenish the body with deficient vitamins and minerals.

The consistency of gel drinks depends on the content of gelling agents and water. Since the recommended rate of collagen consumption is set in the main mass of brands at 5-10 g per serving, even taking into account popular packages that have a volume that does not exceed 75 ml, the gel has a sufficiently viscous consistency. This viscosity can also be obtained by adding 0.4% concentration of xanthan gum, or 0.6% content of gellan, taro or guar gum. It should also be noted that these types of gum combine very well with collagen to form homogeneous stable gels, which can create conditions for falsification.

In this connection, it became necessary to pay attention to the issue of falsification of collagen gels.

In addition, collagen drinks have not yet gained popularity in Ukraine, so the research and identification of general patterns of the formation of the consumption value of similar products, the development of approaches to the classification, terminology and coding of similar products is a necessary step for their use in automated information systems and management tools quality and assortment. Collagen drinks, as a new product for the domestic consumer segment, must be fully standardized and certified in order to properly build an effective quality management system.

#### **Presentation of the main material of the study**

In the process of mastering the production of collagen drinks, the issue of correctly drawing up the stages of the technical task, the sketch project of the product, which create a base of technical and economic data for determining the price of the finished product, but one that would be competitive against similar products of foreign production, becomes of great importance.

A very important role in this is played by the level of quality of finished products – gel collagen drinks – which forms the volume of demand and the size of the company's profit.

Therefore, the application of the pricing mechanism of collagen drinks in the domestic market should not only take into account the main goal of the enterprise – making a profit – but also connect it with compensatory measures from the invested investments, the acquisition of financial stability and stimulation of its growth by finding new niches or markets to increase sales, gain a dominant position among competitors, stabilize achievements in the supply market and create a number of preventive measures against a decrease in demand for products.

Investment measures may consist in the purchase and installation and adjustment of specialized equipment. However, we have developed a technological process in

which expensive equipment is not involved. For the production of collagen drinks, it is possible and worthwhile to use well-known thermal equipment with mechanical mixing devices. Plans were also developed for preparation and post-operation cleaning equipment for bottling, taking into account the complexities of working with collagen and plant extracts. First of all, attention was paid to temperature regimes that do not reach the limits of destruction of collagen and biologically active substances. The viscosity and fluidity of working environments under the developed regimes were also taken into account, which made it possible to reduce the time for preparation for the final sanitary and hygienic operations and reduce the number and time of personnel. For this purpose, a device was used for flushing systems with water supplied under pressure at high temperatures (75-80 °C) of washing solutions without the use of harmful chemical reagents, intended for disinfection of the equipment and its connecting modules.

The search for new niches or markets to increase sales was recommended by us by using different types of packaging and volumes per serving. In addition, for the formation of organoleptic profiles of the samples, the "geography of tastes" approach was implemented, which was built on racial and religious preferences and was carried out within the national traditions of the markets for which the specified products were produced. In this way, consumers received a new product with a taste and aroma that was familiar to them or was popular and at the same time harmoniously combined with the general concept of the product - a collagen-based gel drink.

Gaining a dominant position among competitors was achieved by using gastronomic engineering, namely, combining different flavors and aromas with the use of a dyadic and triadic approach to the formation of flavors, which is not observed among competitors – manufacturers of this product. For example, green tea extract was combined with the aroma of bergamot and shades of citrus. Green coffee extract in combination with chocolate aroma was enriched with hints of vanilla or cardamom. Stabilization of achievements in the offer market was carried out due to the use of the "6 flavors" approach, i.e. in one portion there was a combination of all existing flavors: bitter (due to the addition of extracts of bitter plants), sweet (sucralose with other sweeteners), salty (mineral salts), sour (citric and ascorbic acids), umami (natural enhancers of sweet and salty flavors) and kokumi (the collagen solution itself, which naturally has an enveloping taste or the addition of a creamy or milky or coconut flavor).

And finally, as precautionary measures against a decrease in demand for products, careful tracking of changes in tastes and the creation of a number of offers capable of reproducing different health approaches were used. For example, a collagen drink with immunostimulants, with nootropics, with sedatives, tonic, isotonic, with amino acids, etc.

Taking into account the above methods, wholesale prices were adapted to socially necessary labor costs.

Objective prices were established by relating them to actual production costs or disproportions in the levels of prices for industrial products were eliminated as much as possible, which in the subsequent serial production made it possible to take into account not only the interests of the consumer, but also the development of technical progress, so prices could be delayed at the initial level and do not reduce.

However, the outlined approaches will not be able to be implemented for a long time without the high quality of the finished product, its stability, as well as an understanding of the parameters by which falsification by unscrupulous competitors is possible.

As you know, collagen consists of three amino acids interwoven into long and strong chains. But this is the native form of extracted and dried collagen. There is also hydrolyzed collagen on the market, which is much smaller in terms of molecular size and has been proven to be better absorbed in this form [6, 7].

Native collagen is much cheaper, so falsification can occur precisely for the purpose of replacing the raw material with a cheaper one. It is possible to determine a fake using methods that can establish the degree of hydrolysis of collagen fibers, i.e. quantitative characteristics of peptide bonds, establishing the molecular weight of chains, quantitative content of free amino acids. As already described above, falsification of collagen solutions can occur due to the replacement of gelling agents with polysaccharide substances. The fact of falsification can be established using the Kjeldahl method, which is based on the determination of nitrogen content, or rather its absence in the case of analyzing polysaccharide solutions. In addition, the fact of the presence or absence of peptide bonds can also be established by the Lowry method, based, in particular, on the complexation reaction between a copper ion and an amide group with the formation of a blue-colored solution. In the absence of peptide bonds in the analyzed medium, the solution remains colorless.

By the way, it should be noted that replacing hydrolyzed collagen with non-hydrolyzed collagen can only lead to the fact that such drinks will not be able to quickly realize their functions in the face of an aging body, because the digestibility of native collagen is lower and occurs according to a slightly different mechanism. Large collagen fibers are subjected to pepsinolysis in the stomach and try to be split into amino acids, the assimilation of which occurs already in places of their deficiency. Remains of undigested collagen are not absorbed at all and cannot be used in the biotechnological processes of synthesis of own collagen due to their large mass. Therefore, by the motility of the stomach, they go to the large intestine and must be removed from it as soon as possible, since they can cause a defect in the environment of the large intestine.

#### **Conclusions and prospects for further development of this area.**

Thus, the development of new types of products for existing niches and markets, mastering the methods of checking their quality, building assortment lines

according to consumer requests becomes the basis of the policy of flexible pricing and contributes to the development of scientific and technical progress. At the same time, the role of the consumer focuses more on the choice of quality goods in the middle price segment than on the usual interest in expensive goods, including those of questionable quality. The manufacturer faces a non-trivial task: to ensure innovation in the product, to implement the idea within the established quality standards for this type of product or in the absence of such, to develop and implement a new system (systems) for determining quality indicators for new products that are in demand due to new useful functions and properties. The main task of the developers of such products is to maintain a balance between benefit, quality, moderate price and profitability of the enterprise.

Currently, at the state level, it will be quite difficult for producers of domestic products to improve the quality of food products, raw materials and maintain proper storage conditions for both incoming raw materials and finished products. Therefore, in our opinion, the stability indicator is one of the most important factors in the formation of the quality portrait of a new product – a collagen-based gel drink - and one of the criteria for a product evaluation.

From the analysis of the markets of gel drinks, including collagen drinks, it became known that such products will soon occupy leading positions in the market of beauty and anti-aging products of the domestic production industry. This is due to its high consumer properties and proven effectiveness on the human body. The production of such drinks is profitable, since the main ingredient and packaging are produced in Ukraine. After testing laboratory and research-industrial samples, it can be reliably said that the product is stable during storage, does not require special conditions for transportation and storage (cooling is not required). However, it is not recommended to keep the product in an open state for more than a day under conditions of  $22 \pm 6$  °C and for more than 72 hours at  $4 \pm 2$  °C. It is also not necessary to keep the finished product under the influence of direct sunlight. If the prescribed recommendations are ignored, conditions may be created for the growth of pathogenic and opportunistic microflora, including fermentation processes, which will lead to spoilage of drinks. The global practice of prolonging shelf life consists in using new methods of processing finished products before filling them in packaging containers. For this, physical impact, ultrahigh frequencies, radiation, increased pressure, ultrasound, etc. are used. However, these phenomena are energy-consuming and require specialized equipment, special conditions for its use, and the participation of specially trained personnel in production processes. Less time-consuming and expensive are the stages of the technological process, which apply the principles of preservation with chemical substances and by involving physico-chemical processes, that is, the use of preservatives and pasteurization/sterilization. In the process of production of gel drinks based on collagen, it

is necessary to take into account the fact that protein substances hydrolyze at high temperatures. In addition, the addition of citric acid as a flavoring substance accelerates the peptization process of collagen, which contributes to its better assimilation.

To implement all the processes of collagen cleavage, as well as the maximum preservation of useful substances and quality indicators before the stages of the technological process of beverage production, the stage of preparation of the collagen solution was developed - its heating and pasteurization at a temperature of  $85 \pm 3$  °C in the presence of citric acid. After this stage, the solution was forcibly cooled to a temperature of  $64 \pm 2$  °C and a mixture of bioactivators of metabolic processes was introduced, mixed and the medium for bottling was prepared. In this way of introduction of useful substances (bioactivators), the processes of their destruction do not proceed, the exposure time of the medium at the specified temperatures does not exceed  $18 \pm 3$  minutes.

Thus, it can be stated that the domestic production of collagen drinks, which have not only "beauty" and "anti-age" effects, but also have antioxidant properties and can improve the functioning of internal organs and systems depending on the introduced set of plant extracts and other bioactivators, is necessary and relevant. Given the popularity of these drinks in the markets of Europe, Asia and America, additional marketing efforts will not be necessary, and the innovative approaches used during the development of recipes and creation of food compositions are predicted to be able to interest other countries with an average and low income level. It should also be taken into account that domestic raw materials for the production of collagen do not cause concern in their limitation or access to them. Chemical and biological technologies make it possible to produce different types of collagen, both by type and degree of peptidization. In addition, Ukrainian legislation regarding the quality of raw materials and finished products fully complies with European standards, and regulatory documentation regarding industrial batches of collagen drinks can be prepared quite quickly according to the quality and safety assessment criteria of other countries.

The article provides pricing mechanisms for this product, substantiates the profitability of its production, and outlines the preparatory stages for export. The issues of possible falsification of imported products and/or domestic manufacturers, which may take the position of "unscrupulous competitors", are also touched upon. Techniques for identifying facts of falsification are given. Based on the commodity evaluation, all the described approaches, mechanisms, methods of determination allow us to establish that the developed collagen-based gel drinks can reliably have high nutritional value, quality, and profitability. On the basis of the given characteristics of the input raw materials and finished products, it can be stated that these products will undoubtedly be in demand and occupy a dominant position among health-related products on the domestic

market, which in the future will allow them to be ranked as sought-after export products with a large margin.

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#### **Н. В. КОНДРАТЮК, А. Ю. ЧЕРНЯВСКАЯ, Л. И. ПУГАЧ, К. И. СЫТНИК ТЕХНОЛОГИЧЕСКИЕ И ТОВАРОВЕДЧЕСКИЕ АСПЕКТЫ ПОВЫШЕНИЯ КОНКУРЕНТОСПОСОБНОСТИ ГЕЛЕВЫХ НАПИТКОВ С «ANTI-AGE» ЭФФЕКТОМ**

Цель статьи - описать практические аспекты идентификации гелевых напитков на основе коллагена для выявления признаков их возможной фальсификации. В статье проанализированы технологические аспекты и факторы, влияющие на формирование показателей качества и потребительских свойств гелевых напитков на основе коллагена. Также рассмотрены основные органолептические показатели качества и привлекательности новых видов оздоровительных напитков на основе коллагена. Акцентировано внимание на методах проверки и достижения высокого уровня качества исходного сырья и вспомогательных компонентов. Технология производства в промышленных условиях представлена путем анализа стадий технологического процесса и стадий подготовки рецептурных компонентов для их участия в технологическом процессе. Также рассмотрены практические рекомендации по качественной идентификации желирующих напитков с целью выявления фальсифицированных продуктов, содержащих желирующие агенты небелковой природы. В связи со сниженной платежеспособностью рядовых граждан Украины и курсом украинского правительства на импортозамещение, представленной разработке прогнозируют не только завоевание популярности среди сторонников здорового образа жизни, но и в ближайшее время занятие лидирующих позиций среди тех, кто стремится отсрочить появление признаков старения или предотвратить преждевременное старение. В статье изложены аспекты идентификации гелевых напитков на основе коллагена; обосновывается необходимость обнаружения возможных признаков фальсификации, приводятся методы выполнения таких исследований.

**Ключевые слова:** товароведение, гелевые напитки, «anti-age» эффект, технологии, организация производства

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Метою статті є опис практичних аспектів ідентифікації гелевих напоїв на основі колагену для виявлення ознак їх можливої фальсифікації. У статті проаналізовано технологічні аспекти та фактори впливу на формування показників якості та споживчих властивостей гелевих напоїв на основі колагену. Також розглянуто основні органолептичні показники якості та привабливості нових видів оздоровчих напоїв на основі колагену. Акцентовано увагу на методах перевірки та досягнення високого рівня якості вхідної сировини та допоміжних компонентів. Технологія виробництва в промислових умовах представлена шляхом аналізу стадій та технологічного процесу, а також етапів підготовки рецептурних компонентів для їх участі в технологічному процесі. Також розглянуто практичні рекомендації щодо якісної ідентифікації гелеподібних напоїв з метою виявлення фальсифікованих продуктів, що містять гелеутворювачі небілкової природи. В Україні гелеві напої тільки набирають популярності, а ось напої на основі колагену у вигляді шотів – новинка для вітчизняного ринку напоїв, оскільки в основному належать до індустрії краси та спортивно-оздоровчого харчування. Сьогодні колагенові напої представлені або у вигляді сухих напоїв (швидкорозчинна форма), або іноземного виробництва. У статті висвітлено аспекти ідентифікації гелевих напоїв на основі колагену; обґрунтовано необхідність їх ідентифікації для виявлення можливих ознак фальсифікації, наведено методiku виконання таких досліджень.

**Ключові слова:** товароведство, гелеві напої, «anti-age» ефект, технології, організація виробництва.