TECHNOLOGICAL SUPPLEMENTARY MEANS FOR IMPROVEMENT OF BEVERAGE TECHNOLOGY

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(Received March 3, 2015; Accepted in revised form April 6, 2014)

Abstract: Processing of raw materials, semi-finished and finished products with the help of a variety of aids is one of the most urgent methods of solving the problem of increasing beverage storage duration. The paper shows the state of a beverage as a disperse system during the process. In the semi-finished products at the beginning of technological chain the process of diffusion is not determined, thus the system of beverages experiences sedimentary instability. The processing of semi-finished and finished beverages before pre-packaging by various technological supplementary means leads to the formation of sedimentary stability, in which a sedimentation - diffusion equilibrium takes place. The hypothetical model of the state of beverage disperse system under the influence of technological supplementary means is demonstrated. Disperse system of beverages can be exposed in three main positions: sedimentary unstable, stable (equilibrium), excessively stable. The brief overview of characteristic features of supplementary means is presented, the latter being used in beverage technology to ensure the stability of products with the help of research data presented by domestic and foreign authors. One of the variants of classification of processing aids is the usage of hierarchical method. Structural and technological characteristics of the subsidiary materials used for durability of beverage upon storage are presented as a classification basis. Signs and stages of classification are marked. The presented embodiment of classification methodology can serve as a basis for the selection of processing with the help of supplementary methods, based on individual characteristics of the structural properties of complex means and substances involved in turbidity formation, as well as for indication of the parameters of materials rational usage in the production line as one of the fundamental factors for the formation of finished products quality.

Keywords: Drinks, durability, technological supplementary means, antioxidants, enzymes, sorbents, flocculants, hierarchical classification method.

UDC: 663.8
DOI 10.12737/11236

INTRODUCTION

A beverage, prepared from natural raw materials presents a complex multi-component, poly disperse system, being in certain equilibrium. A large proportion of beverage substances is arranged, due to their special characteristics (eg., taste, transparency) and is in a colloidal state. Being stored under the influence of various factors, an effect of violation of the physico-chemical equilibrium in the colloidal system of the beverage occurs, and turbidity is formed.

According to the terminology of technical regulations in accordance with the Customs Union "Safety of food additives, flavorings and processing supplementary technological means", substances or materials and their derivatives, which are not the components of food, intentionally are used in the processing of food raw material and in the production of food products for specific technological purposes, and they are removed after achieving the task from those materials, Such food products or residual amounts of them do not have the technological effect on the finished food product.

Processing methods, including the use of subsidiary materials designed to remove excess potential turbidity forming components, can intensify the clarification process and increase the terms of transparency in canned beverages. Processing of raw materials, semi-finished and finished products by a variety of aids is one of the important ways to solve the problem of increasing the resistance of beverages.

Supplementary means used in beverage technology to preserve the equilibrium of the colloidal system of drinks are quite diverse and differ in many ways.

The purpose of this research is to develop a classification of technological supplementary means (TSM), taking into account their structural features and technological orientation, as a methodological basis for the selection of (TSM), improvement of their processes and obtaining high-quality drinks.

OBJECTS AND METHODS OF STUDY

Objects of research are the scientific data of domestic and foreign sources of information. As for research methods, theoretical methods were used: a hypothetical method; methods of analysis and selection of information sources; generalization and systematization of information data; a hierarchical classification method [1].

RESULTS AND DISCUSSION

To achieve this goal it is necessary to solve the following problems:

– to review used to stabilize the beverage of opacities of variable origin;
– to develop a version of the classification of supplementary means by systematizing structural features and technological orientation of 100 stabilizers using hierarchical classification method.

According to the basics of colloid chemistry a disperse system is fundamentally thermodynamically unstable. Therefore, we can only talk about the relative thermodynamic stability of disperse systems. Relative stability is the ability of the system within a certain time to preserve its structure unchanged, i.e. particle sizes and their distribution in the system scope. Sedimentation (kinetic) and aggregate stability of the system are differentiated according to their mechanism. Under the sedimentation stability we understand the ability of the disperse system within a certain time to maintain unchanged particle distribution in the system volume, in other words, system's ability to resist the force of gravity.

Observing the process of sedimentation it is necessary to consider the Brownian motion, in which the microscopic and colloidal particles participate. Brownian motion is a consequence of diffusion, which tends to equalize the concentration of particles over the whole volume. These processes are in constant competition.

During the process the beverage as a disperse system passes through the following options for the competition of processes of sedimentation stability and diffusion:
– In the semi-prepared beverages at the beginning of the technological chain diffusion process is not determined, that is why the system is sedimentation-unstable;
– Processing of semi-finished and ready for pre-packaging beverages due to different technological methods and aids leads to the formation of sedimentation-stable system, in which there is a sedimentation-diffusion equilibrium, i. e., particle distribution is not uniform and stable.

Aggregate stability is the ability of disperse system to maintain the degree of dispersion constant in the course of time, i. e., particle size and its individuality. Under the violation of aggregate stability the coagulation process takes place. In the result of coagulation the system loses its aggregate stability. Due to it, the coagulation system loses its sedimentation stability, and the particles become too large to participate in Brownian motion. The coagulation process undergoes two stages: a hidden and an obvious coagulation during the process. During the former coagulation particles get larger, but do not lose their sedimentation stability. During the latter coagulation the apparent density of the particles is greater than the density of dispersion medium, and a precipitate is formed.

Any outward interference of sufficient intensity promotes the coagulation of disperse system. These effects include: changes in temperature; electric fields and electromagnetic fields attack; action of visible light; mechanical action; addition of electrolytes and so on. The temperature effect on the dispersion of beverages is laid into the basis of some technological methods, in order to coagulate large particles, for example, boiling of wort with hop and sharp cooling of semi-prepared liquors and others.

Figure 1 (in Table 1 there are explanations of the figure) shows a hypothetical model of the disperse system of beverage (DSB) state, when subjected to technological supplementary means (TSM).

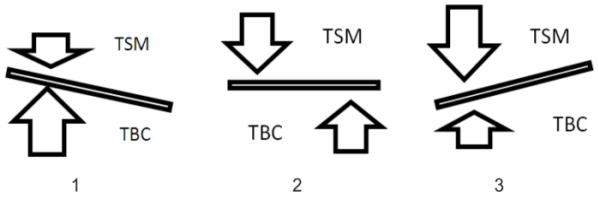

Fig. 1. Hypothetical model of the state of disperse system under the influence of technological supplementary means: (1) unstable DSB, (2) sustainable DSB, (3) "excessively" stable DSB (TBC - components of turbid beverages).

The use of technological supplementary means in the beverage industry allows to put a balance of the quantitative content of potential of turbidity-forming substances, i. e. to prevent hidden coagulation during storage of the beverage and as a consequence, to obtain dispersion equilibrium.

Table 1. Description of the disperse system of the beverage under the action of processing aids

Symbol	Clarification	The result of the effect of TSM on drink quality indices
(1) unstable DSB	The quantitative content of TBC exceeds the quantitative content of the TSM. The probability of suspensions is a maximum.	Violation of appearance of the beverage; visualization of opalescence and sediment; shortening storage
(2) stable DSB	Concentration of TBC is equivalent to the amount of TSM.	Indices of quality beverage meet regulatory requirements; provided warranty deadlines of storage
(3) "excessively" stable DSB	The quantitative content of TBC is excessive in relation to the number of unstable colloids in drink. Probability of suspension is minimal.	A decrease in the organoleptic characteristics of completeness of the beverage flavor and color; decrease of the nutritional value of a drink due to excessive excretion of physiologically active components of a product is observed

Preparing beverages from natural raw materials by application of beverage oxidation technology plays a non-uniform role from the point of view of the formation of organoleptic characteristics and durability of products. Thus, the study of home and foreign scholars in the field of study of biochemical reactions in production of red wines and specialized wines show

that micro-oxidation has a positive effect on the formation of complex flavor characteristics and aging of wine [2, 3].

To prevent turbidity, associated with the harmful effects of oxygen in the beverage technology *antioxidants* are used. A mechanism of interaction of antioxidants with a beverage is quite simple. These compounds interact primarily with oxygen, preventing its reaction with the product, active radicals are inactivated and peroxide forms are destroyed. In beverage industry natural and artificial antioxidants are used. Natural antioxidants include ascorbic and isoascorbic acid, ascorbates, tocopherols, rutin, quercitrin et al [4–7].

Widespread synthetic antioxidants are derivatives of phenols – gallateionol acid ethers, ionol and others [4, 5].

Foreign and home scientists are actively engaged in the research work on the production of antioxidants from natural herbal materials, such as skins and seeds of exotic fruits [8], apple pomace [9], flowers and stems of plants, or such as indigo, jasmine, corn silk [10–12].

In fermentation beverage technology they may use some sulphur compounds as antioxidants: suphfite, bi- and meta-sulphites and potassium metabisulphites. For example, when taking these additives an equilibrium between bound and free SO_2 in beer occurs, which depends primarily on the concentration of free oxygen, as well as physical factors (temperature, pH), and of course, the quality of the raw materials used [4, 5].

To improve the colloidal stability of drinks *enzyme preparations* are widely used, mainly of the hydrolase class - amylase, protease cellulase etc. [4, 14-16]. These biopolymers are used to hydrolyze high molecular components, resulting in formation of material of lower molecular weight, whereby the last are not able to participate in the formation of beverage turbidity.

Enzyme preparations are used to stabilize clear juices, wine, and fruit semis for liquors. Pectins, starch and phenolics are subjected to enzymatic hydrolysis. Pectin molecules are the part of the complex of particles of dregs remaining in juice after extraction. Enzyme activity of proper pectolytic enzymes is not enough for the hydrolysis of pectin dissolved in juice. Moreover, proper pectinmethylesteraza having certain residual activity can lead to the stabilization of the slurry. For the hydrolysis of pectin we use enzyme preparations with high activity of pektinmethyl-esteraza, endopoligalakturonaza, pektinliaza as well as collateral activity of arabinase, glycosidase and protease. Collateral activity is necessary for the enzymatic hydrolysis of the dissolved polysaccharides making up cellular walls. For the enzymatic hydrolysis of starch dissolved we applied enzyme preparations of alpha-amylase or amilogycozidase of filamentous bacterial origin. To remove phenolic compounds the use of enzyme complexes with laccase and difenoloksidaza activity is effective [5, 19].

Enzyme systems are also used to remove contained in beverages oxygen. Thus, glucoseoxidase enzyme system – catalase is used in beer production. Initially, the process of oxidation from glucose to gluconic acid is catalysed by glucoseoxidase. Catalase, in its turn, breaks up hydrogen peroxide obtained to form oxygen and water. Oxygen, released from the second reaction, is involved into the first reaction. Both reactions proceed until the expenditure of oxygen or glucose. This enzyme complex improves the biological stability of beer, not subjected to pasteurization, since under the shortage of oxygen the reproduction of yeast and other microorganisms is suspended [4].

The adsorption methods of beverage stabilization have become widespread. The basis of these methods of lightening substances is stipulated by the adsorption process of colloidal materials or neutralizing of electrical charges colloids of beverages due to introduction of substances with the opposite charge. For this purpose, we use materials of organic and inorganic origin (e.g., diatomite, bentonite, etc.).

Bentonite (bentonite clays) is an aluminosilicate, preferably consisting of a laminate material - montmorillonite mineral and beydelit. Montmorillonite is composed of oxides of silicon and aluminum at a ratio of 4 : 1. In domestic and foreign food industry sodium and calcium-magnesium bentonites are used. Their properties are slightly different [5, 17, 18, 20–22].

Sodium bentonites swell, repeatedly increasing volume somewhat less than those of calcium. The degree of swelling depends on the efficiency of the clarification process - the higher the degree of bentonites swelling, the more efficient lighting becomes. Alongside with the sorption of protein components bentonites remove phenolic compounds (tannins). This property of bentonite is associated with the structure of the bentonite mineral. Sorbent on the main surface of the plates has a negative charge and the edges are charged positively.

In food industries for an effective synersis and greater increase in clarification of beverages, using mineral sorbent, it is combined with a flocculant, in particular with polyacrylamide (PAA), activated carbon [5, 23].

For the adsorption of polyphenolic substances in beverage technology *compounds of organic nature* are used. The reaction between the aromatic hydroxyl group of polyphenols and -CO-NH- in the adsorbenthe is in the basis of interaction.

For instance, the polymer polyvinylpolypyrrolidone (PVPP) - white powder is composed of the same monomers as polyvinylpyrrolidone (PVP) has a ramified structure: PVPP is used in the world beverage brewing and stabilization to remove polyphenols, traditionally used for adding it to diatomite after application of the latter on the filter surface as a filter layer. PVPP absorbs as well nitrogenous substances in the composition of protein- polyphenol complexes [4, 5, 24–27].

PVPP action is analogous to that of the protein properties to bind with polyphenolic substances in the mechanism of turbidity formation. The difference lies in the fact that this process proceeds to considerably faster connections. That is why the introduction of PVPP on filtration stage of a drink takes the drink from the polyphenol fraction and prevents the formation of protein-tannin complexes, as well as the condensation and copolymerization of low molecular weight polyphenols.

To improve the colloidal stability of beverages in domestic and foreign practice *ionites* are also used**.** Ion-exchangers due to covalently bonded ionexchanging groups delay in controlled amounts of proteins and polyphenols.

According to the literature, mechanical density of the resin agarose is so great that it can be destroyed only with a huge mechanical force. Chemical stability of ionexchangers can be broken only by using strong oxidisers or enzymes [4, 5, 29].

The use of *drugs based on silicic acid* is widely distributed in domestic and foreign practice [4, 15, 28, 30-32]. Various industrial names of these drugs: kieselgur, kieselgel, silicasol, silicagel, silicasol - all silicic acid derivatives are related to the class of substances with a large surface area of contact. This means that the sorbent comprises a large number of fine pores. Among currently used stabilizing materials based on silicic acid, in accordance with water content there are distinguished: xerogel and gydrated kieselgel. Progress in the sorbent production technology significantly improved filtration properties by reducing the size of particles, leaving the range without changing the structure. Hydrogel is produced in the same manner as xerogel. However, the final drying process does not occur, so this product is marketed with the humidity of 65%. The only significant advantage of hydrogel with respect to xerogel is, that wherein it is applied the dust is not formed.

Starting component for the production of silicasol is waterglass - solution of special sand, soda ash and water. The choice of sand is the main factor which ensures optimum properties of the resulting silicasol. At later stages of processing liquid glass using ion exchange processes under the control of temperature, pH, pressure, hydrosol of silicic acid is obtained, that is a solution of the smallest silica dioxide nanoparticles. The initial molecule is the molecule of orthosilicic acid. Hydroxyl groups are disposed in a tetragonal form around the silicon atom and denote a silanol group. They are highly reactive compounds and in the formation of Si-O-Si are condensed into polysilicic acid and then form tiny spherical particles having on their surfaces a considerable amount of reactive silanol groups.

Use of kieselgel in brewing is based on the adsorption of protein and tannin compounds (and substances from which they are formed), followed by removal through precipitation of the beer filtration or before filling. Unknown cleavage products in beer or other products do not remain after the reaction, they are stored with some precipitants, such as tannin. For this reason, the use of kieselgel to stabilize the beer does not cause any discussions about its inadequacy to the laws of brewing (Reinheitsgebot - the requirement of product purity) and other requirements to food products. Technology of using Kieselgel to stabilize beer is constantly expanding and, that is of great interest, even in those countries, where there exist other processes and other supplementary means of stabilization of beer are allowed [15, 30-33].

To improve the colloidal stability and tasting berry juices *zeolites* are used [34]. Zeolite is a natural aluminosilicate, whose structure has a tetrahedral shape, and in the grounds of it there are aluminum and silicon ions located, bound by common oxygen ions. Zeolite and kieselguhr (diatomaceous earth), has a large number of fine pores, and wherein removing of the components due to clouding sorption occurs. Zeolite acts as a molecular sieve, it bears a negative charge, which is compensated by the presence in the structure of various metal cations. Cations can replace each other, at the same time zeolite has the properties of ion- exchanger. Zeolite cations are mobile and can be exchanged for other cations of different nature and valence. This property is the basis for modification. The outer surface of the zeolite crystals is small, as compared to the inner volume of adsorption that becomes available after dehydration of zeolite. Its density is low, it is 1.9-2.3 g/cm^3, cation exchange with heavy metals increases it. Furthermore, the density of zeolite depends on the extent, to which the structure is open and what cations are included in their composition. The high selectivity of zeolite adsorbents and their capacity in methabolism is due to molecular sieve effect. Such molecules as $(C_2F_5)_3N$, C_6H_6, $(C_4F_9)N$, C_6H_{12}, n-paraffins, some pesticides can penetrate inside the volume of zeolite.

One of the most important ways to change the properties of zeolites is their modification. The highest sorption capacity is typical for lithium, sodium, potassium, aluminum forms [34].

A certain niche among stabilizing agents is occupied by natural and synthetic *flocculants.* Flocculants are water-soluble macromolecular compounds which, when introduced in disperse systems, are chemically bound to the surface of dispersed particles, the particles are combined into agglomerates (floccules), promoting their rapid deposition. Gelatin is widely used among natural flocculants. It is used to lighten wine, juice, and other products. Gelatin is a protein drug that is extracted from the skin and bones of animals, purified, dried and milled. Gelatin is used in beverage processing for the deposition of polyphenols, which leads to an improvement in flavor, prevents reactions associated with the change in color (brown tone acquisition), and removes the blurred effect of phenol. When processing gelatin with polyphenols flakes are formed, which are deposited, and a fine suspension is carried away with them. The liquor is clarified and its filterability is improved. Efficiency of gelatin increases when used in conjunction with tannin or highly concentrated silica [3, 5, 35, 36].

In the technology of clarification of juices, wine materials and wines the use of natural flocculants, representing microorganisms biomass, such as fungi pleurotus ostreatus and fspergillus niger, takes place [37, 38].

In the domestic technology of preparation of fruit semi-finished products for liquor production polyacrylamide-based flocculants are used [36, 39-41]. Polyacrylamide (PAA) is a synthetic flocculant, amide copolymer of acrylic acid and its salts. The usage of partially hydrolyzed polyacrylamide having a degree of hydrolysis of about 30% is a common practice.

A synergistic effect of it when used in conjunction with coagulants flocculants, has been proved in practice. Application of PAA can reduce the dose of low molecular weight coagulant (e. g., bentonite) several times, greatly increase the rate of deposition of sediment, and the life of the product used for the clarification of the process equipment [36].

One of the applications of flocculants in the technologies of fermented beverages is the reduction of yeast biomass. Flocculants make possible to conglomerate yeast cells with further acceleration of their sedimentation, thereby helping to improve the biological resistance of drinks [39, 41].

In recent years it has become popular to use *hydrocolloids* in the food industry. Despite their very low concentration, they have a strong influence on the physico-chemical and organoleptic properties of food products [42].

Figure 2 shows the production of different hydrocolloids in the world market.

The leaders in the use of hydrocolloids in food products are by far the countries of Western Europe. More than 30% of all manufactured thickeners, gelling agents and stabilizers are consumed by European countries; the US share is approximately 32%, and Asian countries - about 25%. All other countries use about 10%, they include Russia [43].

Today among the most popular food hydrocolloids can be called pure natural substances of animal (gelatin) and vegetable (pectin, agar, gum) origin, as well as products of physical and chemical or enzymatic modification of natural substances - modified cellulose, starches, and others [43].

In the practice of brewing to adjust the quantitative content of polyphenols drugs carrageenan - virflok, Irish moss and others are used, which are introduced by boiling wort with hop. These drugs contribute to intensive formation of protein-tannin complexes [4, 15].

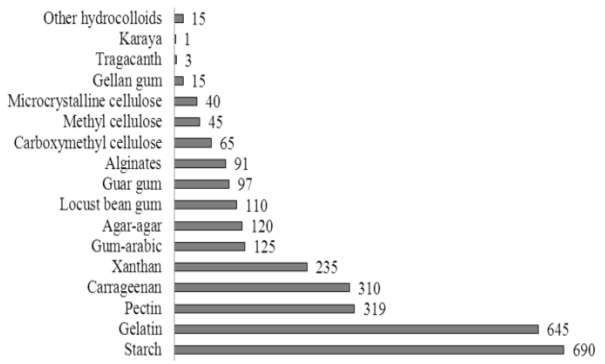

Fig. 2. World production of hydrocolloids, in billion $ [43].

One of the most promising hydrocolloids currently used in food industry is chitosan. Chitosan was at first obtained by Professor Roger C. in the middle of the 19th century. Chitosan is a polysaccharide, which is obtained from the shells of crabs or fungi by removing carbon compound [42].

Chitosan is biodegradable, non-toxic, non-immunogenic and biocompatible with animal tissues. In this connection, the prevailing amount of research has been directed to its use in medical applications. Chitosan is poorly soluble in water, because its bonds between chitosan molecules are stronger than those between molecules of chitosan and water. This hydrocolloid is soluble in acids, such as citric, acetic, oxalic and succinic acids. Chitosan has the ability to retain a solvent in its structure and substances dissolved therein. Flocculation properties of chitosan are exhibited better in solution than in insoluble state [42].

In foreign and domestic practice chitosan actively attracts researchers into the field of protection of food from microbiological spoilage instead of synthetic fungicides [44, 45], as well as a structural generator of nucleated food mixed with protein components in order to improve the physiological properties of medicinal drinks.

Nowadays, the research about the possibility of using chitosan in the beverage industry is conducted to regulate the qualitative composition in order to increase the resistance of the finished beverage [46-48]. Removal of excess beverage potential turbidity-formers as polyphenol and pectin components using chitosan can be explained by the chemical structure of hydrocolloid. In the chitosan molecule there exists a large number of free amino groups, which determines its property to bind hydrogen ions and acquire an excessive positive charge. Therefore, chitosan acts as an active cationic and effectively removes polyphenol and pectin from the reaction medium, bearing in it mostly a negative charge. Decrease in the concentration of protein fraction occurs, possibly due to the initial ion interaction of proteins with polyphenol pectin components followed by their passing into the sediment under the influence of chitosan.

As a glue material in the manufacture of beverages of fruit raw material, starch - potato and maize, are also used [36].

On the basis of the above mentioned data we may conclude that there are various tools to increase the resistance of drinks. Often, different means are used in combination with each other, and if used properly, the additional effect is obtained. At the same time, the ever-increasing production volumes require the search for newer and more effective ways to increase life time of various beverages.

In this paper, we propose a variant of classification of the technological supplementary means used in beverage technology, applying the hierarchical method (Table 2).

The term "classification" means the division of a set of objects into subsets according to certain similarities or differences. Here, under the noting element of "similarity" of the whole complex TSM, the purpose is meant, i.e., ensuring of guaranteed stable transparency of beverages. The division of TSM, according to the differentiation, includes the following subset categories: substances of antioxidant action (anti-oxidants), enzymes, flocculants and sorbents.

Differences between subset groups have different signs. Selection of signs is based on the purpose of classification.

Table 2. Classification of technological supplementary means used in beverage technology to eliminate turbidity

Sets	Sub-sets	Stage			Subset element
		1	2	3	
Additional technological means	Antioxdants, enzymes, flocculants, sorbents	1. Structural characteristic	1.1.Mechanism of action on the component opacities	1.1.1.Chemical interaction	Antioxidants
				1.1.2.Biocatalytic cleavage	Enzymes
				1.1.3.Flocculation	Flocculants
				1.1.4.Sorption	Sorbents
			1.2.Chemical organization	1.1.1. Organic	Antioxidants, enzymes, flocculants, sorbents
				1.1.2. Inorganic	Antioxidants, flocculants, sorbents
			1.3. A process for preparing / origin	1.3.1. Synthetic	Antioxidants, flocculants, sorbents
				1.3.2. Natural	Antioxidants, enzymes, flocculants, sorbents
			1.4. Molecular mass	1.4.1. Low molecular weight	Antioxidants, flocculants, sorbents
				1.4.2. Middle molecular weight	Antioxidants, flocculants, sorbents
				1.4.3.Macromolecular weight	Enzymes, flocculants
			1.5.Aggregate state in the reaction medium	1.5.1.Soluble	Antioxidants, enzymes, flocculants
				1.5.2.Insoluble	Flocculants, sorbents
				1.5.3.Colloidal	Flocculants
		2. Technological directivity	2.1. Impact on the overall	2.1.1. Raw materials	Antioxidants, enzymes
				2.1.2. Intermediate products, semi-finished products	Antioxidants, enzymes, flocculants, sorbents
				2.1.3. Finished product	Antioxidants, flocculants, sorbents
			2.2. Impact on component of production facility involved in the formation of turbidity	2.2.1. Polysaccharides	Enzymes, flocculants, sorbents
				2.2.2. Protein substances	Enzymes, flocculants, sorbents
				2.2.3. Pectic substance Islands	Enzymes, flocculants, sorbents
				2.2.4. Phenolics	Antioxidants, enzymes, occulants, sorbents
				2.2.5. Metals	Antioxidants, flocculants, sorbents
				2.2.6. Production microorganisms	Flocculants, sorbents
				2.2.7. Oxygen	Antioxidants

Signs of the classification are divided into teleological, genetic and technological. Teleological signs define the purpose and use; genetic - initial materials, raw materials, the main components of their chemical composition; processing - design, formulation, manufacturing processes, methods or finishing design.

In this case, the designation of the signs and stages of classification is based on the definition of TSM, regarding following methodological steps: identifying of production facility, then identifying of the component (or components), which will be the object of TSM, and then, on the basis of structural characteristics, making a selection of subset element, i. e., choosing TSM required for the process.

The first stage of the proposed classification is the division of TSM on the following grounds:

– Structural characteristics of accumulating genetic and technological signs of the classification;
– Technological direction - teleological sign.

Detailed classification criteria for the next step involve the properties of TSM, which provide the insight into the structural features of the agent used for the stabilization of beverages and, as a consequence, makes it possible to represent the methodology of interaction and stabilizer of beverages turbidity component. So, TSM is included into the classification of genetic features, with chemical stabilizer organization and the mechanism of action of turbidity component. In the process of preparing – origin, molecular weight and physical state in the reaction medium are the technological characteristics of classification.

There is a teleological sign of classification. In this case the use of (TSM) accumulates the two main aspects - impact on the manufactured object as a component of the flow process from raw materials to final products, and the impact on the actual components involved in the formation of beverage turbidity.

Analysis of the significance of classification contributes to solving production problems, connected with the use of the supplementary means, i.e., helps the manufacturer to identify some aspects of their application, to assess the advantages and disadvantages of a particular material.

In the analysis of the teleological signs of classification - the application of technological orientation of TSM, the specialist of production should initially assign the elements of the process stream, the regulation of composition, which determines the receipt of guaranteed durability in a product. Next, you

need to specify a component, the presence or excessive content of which requires the introduction of TSM. The outcome of these issues is the conclusion on the application of specific tools or complex use of several TSM in order to obtain a synergistic effect.

Technological awareness of a practical working mechanism of TSM in the turbal component allows you to define a rational process step. For example, consider the use of enzymes. Enzymes - is a tool, the use of which is possible in almost any stage of the process stream. Thus, the enzymes are used in brewing and for the treatment of raw materials (for malting), and in the preparation of the wort, and final fermentation compartment. Specialist on the basis of analyzing the components of a process stream determines the stage of the process, which regulates the qualitative composition of the product, will contribute to solving the problem - getting the finished beverage guaranteed durability.

Chemical TSM organization determines production losses related to specific consumption of TSM. For example, using bentonite as a stabilizer for semi-finished products of liquors, which by its chemical nature is an inorganic substance, there are large production losses with sediment during clarification semis. Thus effective dosages are measured in grams per cubic decimeter. While the use of an organic stabilizer, e.g., with the same purpose chitosan stipulates the formation of compact precipitate with introduced dose of TSM, many times smaller and is measured in milligrams per cubic decimeter [40].

Physical state, in which the stabilizer in the reaction medium, predetermines the mechanism of interaction, the method used in the process, allows to identify the stage of the process, which will make rational use of specific FA. For example, the use of flocculants and adsorbents would be the best on semi-holding stage before filtering process, and the use of antioxidants or enzymes does not require filtration after treatment.

A process of preparing / origin allows us to evaluate the economic component of the use of TVS. Thus, synthetic stabilizers, in most cases, are less natural. This, however, relates to enzyme preparations. Molecular mass plays a role in determining the aggregate state and the degree of solubility for the individual elements of a subset of stabilizing agents such as flocculants and sorbents.

We describe the algorithm of specialist actions in production of alcoholic beverages by analyzing the classification criteria of presented above version of classification. For example, we may consider the widespread sorbent – bentonite, used as an aid in the technologies of various drinks.

1. Analysis of teleological signs.

– We denote the production facility - or semi-finished liquors - alcoholized berry juice, fruit infusions. Consequence – element of subset is not defined;

– Morse component chemical composition, which requires adjustment of the quantitative content - the complex slurries that consist of polyphenol, pectin and proteins. Consequence - a subset of the excluded item "enzymes".

2. Analysis of genetic signs.

– Mechanism of action of the component haze - sorption or flocculation. Consequence - the specification of element subsets "sorbent" or "flocculent" as well as the stage of its use - treatment is available at the stage before filtration pasting semiproduct, we stop the choice, for example, on an element subset "sorbent" and denote a representative of this group – bentonite;

– Chemical organization - an inorganic substance.The investigation - necessity to consider losing semis with sediment.

3. Analysis of technological features.

– A process for preparing /in origin - natural, and has a low cost, which is one of the advantages of the assembly;

– The molecular weight - middle molecular;

– Physical state - insoluble sorbent in the reaction medium is a suspension.

Consequence of the analysis on this stage is the designation of specific use of bentonite to stabilize the fruit beverages (fruit infusions).

According to the above classification TSM, bentonite is a low molecular weight natural insoluble adsorbent of inorganic nature, used to stabilize the semi-finished products of alcohol beverages by the method of sorption turbid substances. Thus, in practice, the experts in this branch prefer to use bentonite in combination with any flocculant in order to obtain synergies and accelerate the process of infusion pasting.

Any supplementary means used in the practice of production for the equilibrium beverage system obtains signs, presented in this classification. Furthermore, within the element subsets, there are specimens, which have, for example, identical technological characterristics, while at the same time they have distinctive structural characteristics (e.g., bentonite and chitosan).

Thus, the shown embodiment of classification may serve as a methodological basis for selection of TSM, if taken into consideration individual structural characteristics of these means and properties of the substance complex involved into turbidity process, as well as to indicate the parameters of rational use of TSM in production line as one of fundamental factors for the formation of finished product quality.

REFERENCES

1. Nikolaeva, M.A., *Teoreticheskie osnovy tovarovedenija* (Theoretical Foundations of merchandising), Moscow: Norma, 2007. 448p.
2. Gomez-Plaza, E., and Cano-Lopez, M., A review on micro-oxygenation of red wines: claims, benefits and the underlying chemistry, *Food Chemistry*, 2011, no. 3, pp. 1131-1140.
3. Valuiki, G.G., *Tehnologija vinogradnyh vin* (Technology of wines), Simferopol: Tauris, 2001. 624 p.
4. Meledina, T.V., *Syr'e i vspomogatel'nye materialy v pivovarenii* (Raw and subsidiary materials in brewing), St. Petersburg: “Professija” Publ., 2003. 304 p.

5. Sarafanova, L.A., *Primenenie pishhevyh dobavok v industrii napitkov* (The use of dietary supplements in the beverage industry), St. Petersburg: "Professija" Publ., 2007. 240 p.
6. Sidani, B., and Makris, D.P., Interactions of natural antioxidants with red grape pomace anthocyanins in a liquid model matrix: stability and copigmentation effects, *Chemical industry and Chem. Eng. Quart.*, 2011, no. 1, pp. 59-66.
7. Kowalczyk, J., Hausmanns, S., and Dorr, T. *Antioxidationsmittel auf Basis von Application Trehalulose*. Patent Germ., no. 102008027686.3, 2009.
8. Ayala-Zavala, J.F., Rosas-Domingues, C., Vega-Vega, V., Palafox-Carlos, H., Villa-Rodrigues, J.A., Siddiqui, Md.Wasim., Davila, J.E., Gonzalez-Aguilar, G.A., Agro-industrial potential of exotic fruit byproducts as a source of food additives, *Food Res. Int*., 2011, no. 7, pp. 1866-1874.
9. Ajila, C.M., Brar, S.K., Verma, M., Tyagi, R.D., and Valero, J.R., Solid-state fermentation of apple pomace using Phanerocheate chrysosporium, liberation and extraction of phenolic antioxidants, *Food Chemistry*, 2011, no. 3, pp. 1071-1080.
10. Zhigang, T., Cai, L., Dai, L., Dong, L., Wang, M., Yang ,Y., Cao, Q, and Ding, Z., Antioxidant activity and chemical constituents of edible flower of Sophora viciifolia, *Food Chemistry*, 2011, no. 4, pp. 1648-1654.
11. Huo, L., Huo, R., Lu, P., LLi, Y. Liao, Chen, P., Deng, Ch., and Lu, X., Antioxidant activity, total phenolic, and total flavonoid of extracts from the stems of Jasminum nervosum Lour, *Grasas y aceites*, 2011, no. 2, pp. 149-154.
12. Liu, J., Wang, C., Wang, Z., Zhang, Ch., Lu, Sh., and Liu, J., The antioxidant and free-radical scavenging activities of extract and fractions from corn silk (Zea mays L.) and related flavones glycosides, *Food Chemistry*, 2011, no. 1, pp. 261-269.
13. Yu-Chi, Chen. Yu Shu-Huei, Tsai Guo-Jane, Tang Deh-Wei, MiFwu-Long, Peng, Yu-Ping., Novel technology for the preparation of self-assembled catechin, gelatin, nanoparticles and their characteristics, *J. Arg. and Food Chem.*, 2010, no. 11, pp. 6728-6734.
14. Titze, J., Herrmann, A., and Ilberg, V., Ein chemisch-physikalischer erklarungsansatz, *Brauindastries*, 2012, no. 4, pp. 14-17.
15. Narciss, L., and Bak, V., *Kratkij kurs pivovarenija* (A Short Course of brewing), St. Petersburg: "Professija" Publ., 2007. 640 p.
16. Bible, C., Enzymes in the brewing process, *Zymurgy*, 2012, no. 4, pp. 53-56.
17. Stankovic, S., Jovic, S., Zivkovic, J., and Pavlovic, R., Influence of age on red wine color during fining with bentonite and gelatin, *Int. J. Food Prop*., 2012, no. 2, pp. 326-335.
18. Ageev, N.M., Andreev, V.G., and Dunets, R.V., Obosnovanie rezhimov aktivacii montmorillonita dioksidom sery (Justification activation modes sulfur dioxide), *Vinodelie i vinogradarstvo (Winemaking and Viticulture)*, 2012, no. 4, pp. 16-18.
19. Ageev, N.M., Gnetko, L.V., and Belyavtseva, T.A., Vlijanie fermentnyh preparatov na biopolimernyj kompleks plodovyh sokov (Influence of enzyme preparations on biopolymer complex of fruit juices), *Vinodelie i vinogradarstvo (Winemaking and Viticulture)*, 2012, no. 4, pp. 24-25.
20. Koshelev, Y.A., Kuleshov, N.I., Batashov, E.S., Sevodin, V.P., Chumichev, A.I., and Pyrozhkov, A.S., *Sposob osvetlenija oblepihovogo soka* (Method of sea-buckthorn juice lightening). Patent RF, no. 2402960, 2006.
21. Sobolev, E.M., Stafionov, I.K., Mishin, M., and Talanyan, O.R., *Sposob otrabotki susel i vinomaterialov betonitom* (A method of processing musts and wine bentonite). Patent RF, no. 2224016, 2004.
22. Oganesyants, L.A., Reytblat, B.B., Dubinchuk, L.V., and Kucherjavyj, L. M., *Sposob proizvodstva vina igristogo jablochnogo* (A method of producing sparkling apple wine). Patent RF, no. 1124129, 2011.
23. Nikitin, P.V., and Novikov, I.L., *Sposob proizvodstva neosvetlennogo i osvetlennogo koncentrata soka topinambura* (A method of producing a clarified and unclarified concentrated juice of Jerusalem artichoke). Patent RF, no. 2444914, 2012.
24. Ulrich, S., Always bright: new regenerative beer stabilization system, *Brewing and Beverage Industry*, 2011, no. 5, pp. 64-66.
25. Bernhard, Gris, *Sposob poluchenija prozrachnogo i rastvorimogo zernovogo jekstrata* (A method for producing a transparent and soluble corn extract). Patent RF, DK, no. 2011137543/13, 2013.
26. Earl Graham James, Ian Patrick McKeown, *Stabilizacija napitkov* (Stabilization drinks) Patent WO, no. 02/057403, 2006.
27. Namazbayev, V.I., Tcharykov, N.A., Keskin, V.A., and Neumark, M.S., *Sposob stabilizacii vinogradnogo vina* (The method of stabilization of wine). Patent RF, no. 2418854, 2011.
28. Kreb, J., Kreb, M., Boehm, M., Duck, S., and Fratianni, A., kieselgurfreie anschwemm-filtration in bestehenden filterlinien, *Brauindustrie*, 2011, no. 4, pp. 38-42.
29. Kattske, Michael, Berglef, Yang, Vretblyud, Per, and Nendtsa, Ralph, *Sposob stabilizacii napitkov* (A method for stabilizing drinks). Patent WO, no. 97/43401, 2003.
30. Nimsh, K., and Nikolashkin, F.V., Silikazol' i silikagel' – aspektyk achestva (Silica sol and silica gel - aspects of quality), *Pivo i napitki* (Beer and beverages), 2005, no. 2, pp. 26-28.
31. Falk Uwe, Zhakono Eric, Peyrard Marie Laure, *Primenenie kolloidnogo anionnogo kremnievogo zolja v kachestve osvetlitelja* (The use of colloidal anionic silicasol as a clarifier). Patent WO, no. 2004/003128, 2008.
32. Beer stabilization: a profile of one of the pioneers of silica gel stabilization, *Stabifix Braveries Technic: Brew. Guardian*, 1998, no. 5, pp. 24-26.

33. Kilcast, D., and Subramaniam, P., *Food and Beverage Stability and Shelf Life*, Woodhead Publishing Series in Food Science, Technology and Nutrition, 2011, 849 p. (Russ. ed.: Kilcast, D., and Subramaniam, P., *Stabil'nost' i srok godnosti. Bezalkogol'nye napitki, soki, pivoi vino*, St. Petersburg: "Professija" Publ., 2013. 384 p.).
34. Shatirishvili, Sh.I., Maharoblilze, M., and Tsereteli, Kh.Sh. Influence of different technological methods and materials for fining wine colloidal stability, *Bulletin of Agricultural Science*, 2011, no. 3, pp. 94-96.
35. Avanesyants, R.V., Ageev, N.M., Avanesyants, R.A., and Jakub, Y.F., *Sposob proizvodstva krepkogo napitka* (Process of producing a strong drink). Patent RF, no. 2458115, 2012.
36. Burachevsky, I.I., Zaynullin, R.A., Kunakova, R.V., Polyakov, V.A., and Fedorenko, B.I., *Proizvodstvo vodok i likerovodochnyh izdelij* (Production of vodka and liqueurs), Moscow: DeLee print, 2009. 324 p.
37. Shcherbakov, S.S., Giryavenko, A.V., and Kolesnikova, V.F., *Sposob obrabotki vinomaterialov* (A method of processing and wine tasting). Patent RF, no. 2349639, 2009.
38. Polyakov, A.G., Shevchenko, N.N., Chernykh, V.S., and Smol'ianinov, V.V., *Sposob osvetlenija soka* (Method of clarifying juice). Patent RF, no. 2252261, 2005.
39. Sergeeva, I.Yu., Pomozova, V.A., Shevchenko, T.V., Syrovatko, A.L., and Zakharenko, D.G., Primenenie flokulyantov dlya povysheniya stoykosti sbrozhennykh napitkov (Use of flocculants for increase of stability of fermented beverages), *Pivo i napitki (Beer and beverages)*, 2007, no. 5,pp. 24-27.
40. Pomozova, V.A., Sergeeva, I.Yu., Kiseleva, T.F., Shevchenko, T.V., and Bikmulina, N.O., Ispol'zovanie flokulyantov dlya udaleniya polifenolov iz spirtovannykh morsov (Use of flocculants with the aim of removing polyphenols from alcohol based beny juices), *Proizvodstvo spirta i likerovodochnyh izdelij (Manufacture of alcohol liqueur & vodka products)*, 2005, no. 1, pp. 17-19.
41. Sergeeva, I.Yu, Shafray, A.V., and Zakharenko, D.G., Modelirovanie protsessa osvetleniya napitkov brozheniya s pomoshch'yu vspomogatel'nykh sredstv (Modeling of clarification process of fermentation drinks with subsidiary substances), *Technika i technologiia pishchevykh proizvodstv (Food Processing: Techniques and Technology)*, 2013, no. 3 (30), pp. 58-61.
42. Phillips, G.O., and Williams, P.A., *Spravochnik po ghidrokolloidam* (Handbook of hydrocolloids), St. Petersburg: GIORD, 2006. 536 p.
43. Prokhorova, A.V., Novye tendentsii na rynke gidrokolloidov (New trends in the market hydrocolloids), *Prodindustriya*, 2005, no. 3, pp. 90-92.
44. Yang Ling-Yu, Zhang Jian-Lei, Basset Carole L., and Meng Xian-Hong, Difference between chitosan and oligochitosan in growth of Monilinia fructicola and control of brown rot in peach fruit, *LWT "Food Science and Technology"*, 2012, no. 1, pp. 254-259.
45. Alvares, Maria V., Ponce Alejandra G., Moreira Maria del R., Antimicrobial efficiency of chitosan coating enriched with bioactive compounds to improve the safety of fresh cut broccoli, *LWT - Food Science and Technology*, 2013, no. 1, pp. 78-87.
46. Safronova, T.M., Maksimova, S.N., Bobyleva, A.E., Shafray, A.V., *Sposob osvetleniya plodovo-yagodnogo soka* (Way of fruit juice clarification). Patent RF, no. 98117099/13, 2000.
47. Sergeeva, I.Yu., Pomozova, V.A., Vechtomova, E.A., and Kuzmin, K.V., Primenenie prirodnyh stabilizatorov v tehnologii likerovodochnyh izdelij (The use of natural stabilizers in technology of liquors), *Proizvodstvo spirta i likerovodochnyh izdelij (Manufacture of alcohol liqueur & vodka products)*, 2011, no. 3, pp. 28-30.
48. Sergeeva, I.Yu., Pomozova, V.A., Vechtomova, E.A., and Kuzmin, K.V., Ocenka vlijanija hitozana na udalenie biopolimernyh komponentov pomutnenij napitkov (Assessing the impact of the removal of the biopolymer chitosan components opacities of drinks), *Pivo i napitki (Beer and beverages)*, 2013, no. 3, pp. 28-30.