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USING THE PROFILE METHOD FOR EVALUATION THE BEER QUALITY

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Abstract. The expediency of using the profile method of analysis for assessing the influence of technological factors on the quality of beer has been established. The characteristics for the evaluation of beer quality by the profile method are chosen. The results obtained using the profile method give a more complete picture of the properties of beer than the results of the scoring method. Each of the samples was analyzed and studied. The results of analysis of such criteria as aroma, flavor, appearance and physicochemical parameters are demonstrated on profilograms. Estimation of flavor is the most difficult, since this concept includes a complex sensation of taste, aroma and consistency, determined in the oral cavity. To confirm the organoleptic properties of the «body» of the best sort of beer, rheological analysis data were presented. Such an integrated approach will allow fully studying the properties of a low-alcohol beverage and clearly demonstrating the advantages of a profile method of analysis.

Keywords: beer, quality, the profile method, organoleptic testing method.

ВИКОРИСТАННЯ ПРОФІЛЬНОГО МЕТОДУ ПРИ ОЦІНЮВАННІ ЯКОСТІ ПИВА

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Анотація. Встановлено доцільність використання профільного методу аналізу для оцінки впливу технологічних факторів на формування якості пива. Обрано характеристики для проведення оцінки якості пива профільним методом. Результати, отримані при використанні профільного методу, дають більш повне уявлення про особливості властивостей пива, ніж результати балового методу. Кожен із зразків був проаналізований та вивчений. Результати аналізу таких критеріїв, як аромат, флейвор, зовнішній вигляд і фізико-хімічні показники продемонстровані на профілограмах. Оцінювання флейвора є найбільш складним, так як це поняття включає комплексне відчуття смаку, аромату і консистенції, яке визначається в ротовій порожнині. Для підтвердження органолептичних властивостей «тіла» найкращого сорту пива були приведені дані реологічного аналізу. Такий комплексний підхід дозволить повністю вивчити властивості слабоалкогольного напою та наочно продемонструвати переваги профільного методу аналізу.

Ключові слова: пиво, якість, профільний метод, органолептичний аналіз.

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Introduction. The problem statement

In assessing the products quality control the accordance of organoleptic characteristics requirements of normative document ISO 6658:1985 «Sensory analysis – General guidance», USS ISO 6658:2005 «Sensory Study. Methodology. General guidelines» and USS 7103:2009 «Beer. Methods for determination of organoleptic characteristics and volume production». This is connecting with organoleptic characteristics of quality. These characteristics show the complex of properties which depend on compositions of food products, quality of raw, features of technology and storage. Also, the human's sensory systems are the most perfect and adapted senses for assess taste and smell of products to date [1,2].

Objective. To explore the possibility of using a profile method of analysis to assess the influence of technological factors on the quality of dark varieties beer.

However, for getting the reliable information using human's senses it is necessary to follow the relevant study methodology. The modern organoleptic testing methods for assessing the quality allow to assess the quantity of intensity taste and smell (using the method of diluting index) and to rate the quality of product in scores (using the method of rating in scores). Deep analysis of quality per organoleptic characteristics allow to undertake the profile method of analyses. The principle of method is to split the senses to different constituents and to assess the organoleptic intensity of this senses [3].

Literature review

The most important factors in assessing the quality of beer is determination of organoleptic parameters during the tasting according to international requirements and standards.

To concentrate the aromatic compounds of beer, the upper part of the glass must be narrowed. The temperature of the drink of bottom fermentation in the glass is 12 °C, in the top – 15 – 16 °C. The definition of taste and aroma of beer is limited to 5 – 8 samples. Light snack during the tasting of beer is low-fat cheese, boiled meat, wheat bread, etc.

Light beer is judged by hop bitterness, and dark beer is judged by the fullness of taste and malt aroma. Transparency with gloss without suspended particles is estimated at three points, transparency without shine – two, with weak opalescence – one, turbid – zero (non-standard). The pure aroma corresponding to this type of beer is estimated at four points; pleasant, but weakly expressed – three points; if there are visible light foreign shades of young beer and yeast – two; in the fragrance are expressed extraneous shades – one point.

The foam and the saturation of CO_2 are evaluated as large, resistant if its thickness is not less than 40 mm. Persistence of 4 minutes with a high content of CO_2 is estimated at five points; compact foam height of 30 mm and resistance of 3 minutes with a rare and rapid release of gas bubbles – four; foam height of 20 mm and a persistency of 2 min with a weak allocation of gas bubbles - three; foam height less than 20 mm and resistance less than 2 min – two points.

The company «Ukrpivo» under the leadership of the General Director Korenkova A.M. has developed a code of honor and unity of Ukrainian producers of beer and non-alcoholic products. The codec is an agreement about the rules of professional activity and standard business activities. The basic rules include:

- compliance with the norms of the current legislation of Ukraine;
- support for the principles of building a democratic society;
- mutual respect and fair competition between producers, respect for the consumer;
- fulfillment of deliveries to the Ukrainian market and for export of safe for health and high-quality products, which meets the requirements of state standards and the introduction of progressive energy-saving technologies, highly efficient equipment and world experience in the beer and nonalcohol industry;
- prevent the use of low-quality raw materials (below grade 2) in the production of beer and non-alcoholic products;
- do not allow in the production process violations that affect the quality of products and the preservation of the environment;
- use the principle of complete informative of sellers and consumers about the properties of the product.

The profilogam of product's organoleptic characteristics best represents the quality in rectangles. That's how, the rectangle's high and width correspond to sense's intensity and importance of selected figure respectively. The references in corresponding order on the abscissa axis corresponds the order of received senses [1-2,4-5].

The major part

For the assessing of the dark beer's quality using the profile method there were chosen figures, presented in the table 1.

The chosen characteristics allow us to assess the influence of technological factors on beer quality form. The form of beer quality begins from technological operation of grain storage. The biochemical transformation of grain substances, which are need to form the aromatic, taste and dyeing substances of dark malt, occur in the moment of barley malting. The main quality differences in the light and dark malt are aroma, taste and color, which we can obtain during malt drying. In the process of malting producing dark malt is need to accumulate a high amount of amino acids and carbohydrates in the grain. First condition of the accumulation a high amount amino acids in the malt is possible when there is a big amount of proteins in the barley. The second condition is deeper proteolytic decay of proteins. This process is possible only after accumulation in the grain high activity of proteolytic enzymes and after creation all favorable conditions for these enzymes success work. Th third condition that amino acids should not be used by alive germ in the stage of protein declay creation. That means that we need to stop the growth of malt germ [8,9].

So, for dark malt producing is need to choose the barley with well and quick growth and with big amount of protein. High protein barley should be soaked with the humidity no less than 45-47%. The average temperature in the first days of barley dipping should be 15 – 18 °C. After quietly enough development of germ, the grain should be germinated and fermented in the atmosphere of high amount carbonic acid, which formed in the result of grain breathing with micro aeration and ventilation. Also, that should provide the temperature till to 20 – 22 °C. In the several occasions (depending on varietal specifics of barley) the temperature can be somewhat higher. All these activities can be made using different technological methods (depending on equipment of malt-house) [10].

Green malt is the intermediate product and is not used in for wort receiving. It has malt germ which give a beer bitter, unpleasant taste. That could be explained a chemical composition of germ and mainly presence of hordenine (hydroxyphenyl dimethylamine). The full removal of germs is possible only after drying of green malt. There are deep biochemical, chemical and physico-chemical processes flowing into malt in the period of drying. The carbohydrates and amino acids which the malt have, join the chemical interactions. They condense and give the dyeing, tasting and aroma substances. Part of carbohydrates, especially monosaccharides, fructose

and xylose, acidify and caramelize. The part of high-molecular proteins denatures and fold. The starch is easily succumbing to impact of enzymes on the next stages of getting mash from malt [11].

Table 1 – The figure's characteristic which were chosen for assessing the dark beer's quality using the profile method [6, 7]

Figures	The substance, influenced senses and technological stage on which the specific incentive is forming
Aroma	
Burnt malt	Bitter and pungent aroma of dark kind of beer come from excessive pressure after adding to the wort a big amount of prepared incorrectly hot punch as a grinding, not as its extract.
Sweetness	Non-fermented carbohydrates mostly give the sweetness into beer.
Burnt	This aroma in beer is the consequence of using low-quality dark or caramel malt.
Bread crust	The aroma of bread crust (similar with the aroma of rye bread) emerged after pasteurization of mild beer, especially using high-temperature mode of pasteurization
Fruity	Fruity aromas in beer is consequence of incorrectly choosing yeast's race, a deficient of yeasts in feed yeasting stage, high temperature of fermentation process
Acidity	Hydrogen ion aroused acidity sense. Its quantity is associate with the degree of acids' and acid salts' dissociation.
Yeast aroma	This aroma appears using old yeasts after their autolysis.
Flavor	
Not hopped bitterness (-)	Tanning agents of melt's bran and malted barley have very unpleasant bitterness which, after adding in the beer give it a rude, bitter taste which is different from hopped.
Rude (-)	Bitter, unpleasant taste give the beer the products of yeasts after their autolysis.
Tart	Disagreeable tart taste almost has beer from the hard carbonate and very alkaline water.
Well-balanced	Clear taste and aromas of fermented malted beverage with the hops bitterness and aroma have any foreign odor and/or taste.
Immature	The beer which have had short or slow fermentation has immature taste. The reason of this immature taste are mercaptans and some aldehydes on one side, and volatile sulphuric compound (hydrogen sulphide and sulphur dioxide) which formed in the fermentation main stage.
Phenolic	Phenolic (carbolic, hospital) has many reasons. First reason is using technical water with high quantity of nitrates in beer production. The reason of that can be also free chlorine if the malting barley soaking in the water with addition of bleach or filter mass which sterilized be bleach without chemical separation (using sulfites).
Caramel	The caramel taste of beer is consequence of using low-quality, old, dark or caramel malt or the consequence of using big difference of temperature between mash-vat wall and mash or between brew kettle wall and mash.
Sour	Hydrogen ion aroused acidity sense. Its quantity associate with the degree of acids' and acid salts' dissociation. Another reason of this taste is the high temperature of fermentation and after-fermentation processes.
Basement	Basement taste are the different deviations from the normal clear taste. We can find them in the beer which has shortcoming in production. The most commonly reason is absence of purity in production equipment or environment.
Honney	The large amount of sarcina is the reason of increasing the quantity of Diacetyl, who has specific honey taste. The normal quantity of diacetyl doesn't have such result in the normal process of fermentation.
Bread crust	The aroma of bread crust (similar with the aroma of rye bread) emerged after pasteurization of mild beer, especially using high-temperature mode of pasteurization
Yeast	Poignant yeast taste appears in the beer by pumping in the cellar mild beer with big amount of unsettled yeasts. And if the storage temperature of beer or barm is elevated, this taste will progress intensively.
Sunny	The sunny taste is very obnoxious and it appears in beer from bottles (and in beer from glass) because of direct sunlight or continuous action of diffuse daylight or light source. The result of this defect is photochemical impact of ultraviolet on sulfhydric groups of extractive substances with ethyl mercaptan forming.
Residual bitterness	Beer's bitterness is the most complex kind of taste. The reason of which is α-resin and α-bitter acid of hop. β-bitter acid and β- and γ-resins have significantly lower bitterness. The degree of dispersion has a big value in the taste of bitterness. If the degree of dispersion increase, the amount and the area of particle increase.
Malt's aroma	The pentosas are split out when pentosane decompose in the process of malt drying. These pentosas after the next stages of decomposing give furfurol and others aldehydes and other aromatic compounds. All these molecules can give the Malt's aroma.
"Body"[1]	Bitter substances have the property of protective colloids and they stabilize the others unstable beer colloid. Gum-shaped and pectin matters of beer influence viscosity. They increase the beer viscosity and give the foam stability.
Flat[2]	The complete beer should have taste completeness. The reason of such beer property is not because of high extract content. The reason of that are the beer matters, especially proteins and bitter resins. When proteins and bitter resins are in the dispersion solution shape, they highly extend on the papillae of tongue. Because of it there is a filling of the palate fullness – "oiliness". As opposed to it the beer can have empty (flat) taste.
Appearance	
Clarity	The beer transparency is created with the clarification in the period of aging, with the filtration and separation. The beer needs to be clear, and bottled beer needs to be necessarily crystal clear, with brilliance.
Brilliance	If the clarification was good, the beer will be clear, sparkling (with brilliance). There is low reduction of hydrogen ions because of colloid's settling-out which have acid character (hop's resins and proteins substances).
Color	The color of beer is created during brewing and depends from color and quality of malt, from composition of process water, from the quality of hop and from other technological operations.
Foam	Proteins and their degradation products, as well as bitter substances of hops, as substances greatly lowering the surface tension, promote the formation of foam and retaining carbon dioxide bubbles. To form a fine and persistent foam is desirable to optimize the value of the colloidal particles.

Note: 1 – "Body" means impression from beer consistency. The possible meaning is "flavor intensity".

2 – Term "flat" is the characteristic with the impression lower then organoleptic level.

Malt milling is very important technological stage. The speed of wort saccharification, total amount of extract, time of wort filtration depends on quality of malt milling. The increase of malt extract amount depends on the way of mashing. Choosing the level of milling needs to pay attention to equipment for filtration (means filter vat or filter-press).

In the dry malt, big amount of substances is in an insoluble state. The objective of engineer producing mash is creating the best conditions for the reaction of enzymes. They must carry the maximum number of solids in the soluble state and obtain maximum yields of the extract from the dry malt. However, this is only the first and relatively easy task. It is need to provide the specific composition of the extract, which would meet the quality of different types of beer. Malt enzymes are the biological catalysts. They have a remarkable property to act only on strictly certain malt substance and to work in strictly defined conditions. Cleavage of starch in the process of meshing and saccharification of wort can be adjusted mainly by changing the temperature and acidity [12-13].

Saccharified mash is made up of solids - beer pellet - and liquid - beer sweet mash. Wort filtration is necessary to separate the grist from the mash with minimal loss of extractives.

First mash during the filtration is collected with the washings in the brew kettle. There it is boiled with hops. During boiling, there are the mash evaporation till to desired density and the mash sterilization, the inactivation of enzymes. Also, there are the processes of partial coagulation the dissolved proteins, leaching, dissolution and conversion of the bitter substances and aromatic hops. When mash boils, the proteins coagulate into large flakes and precipitate, the wort is clarified. Great influence on these processes, in addition to boiling, turn out the hop tannins, as well as the pH of the mash. Bitter and aromatic hop tannins which were born in boiling, give bitter taste and aroma typical for this beer. They preserve beer mash and increase the resistance of it. To prepare the hot hopped mash to the fermentation, it is cooled to 4 – 6 °C for removing curled proteins [14-15].

The results approbation. The samples of three brands of dark beer were analyzed with the power profile method. The results are shown in figure 1-3.

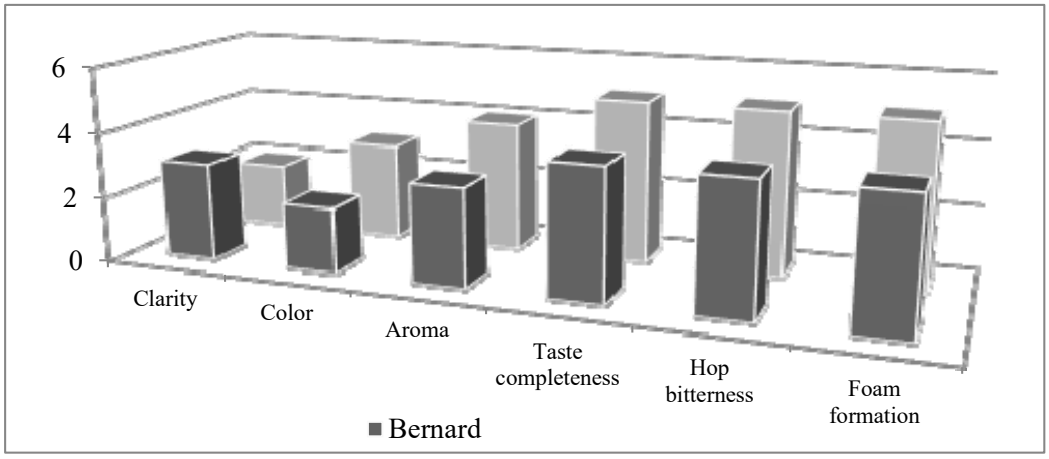

Fig. 1. Comparative profile diagram of beer organoleptic (varieties Bernard and Lustdorf)

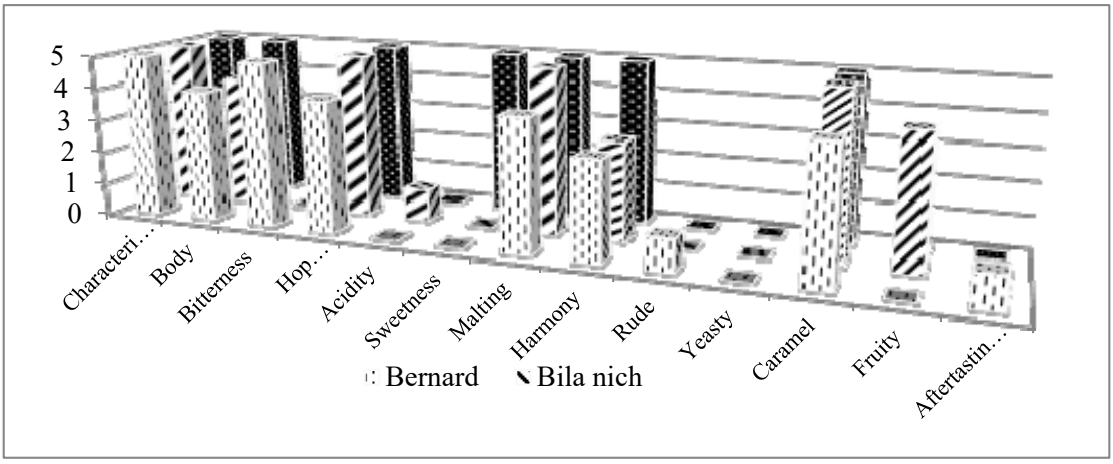

Fig. 2. Flavor profile diagram of research beer varieties

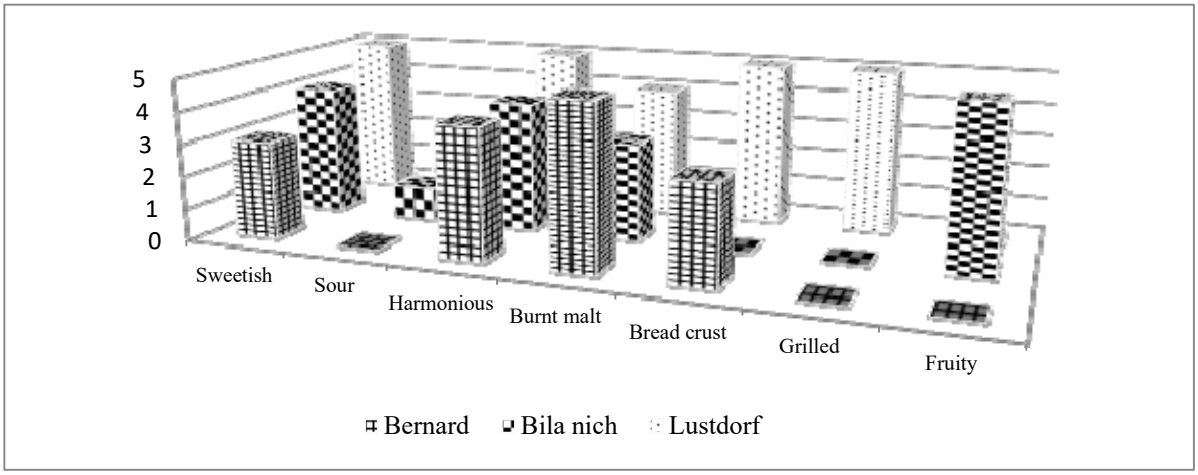

Figure 3. Aroma profile diagram of research beer varieties

The composition of the beer samples «Lustdorf» and «Bernard» is the same for the data specified on the label. However, the profile method allows significant differences the high harmony of the sample «Lustdorf» beer, which may be associated with the peculiarities of production technology. For such kind beer producing is using barley malt Pils (76 %), and malt Caramell (19 %) and Carafa (5 %). In the technology, the wet milling is using. It offers to save bran wholeness of malt raw and this is increasing the quality of wort filtration. Worting the maltose pause has the duration in 30-45 min with the temperature of 30 – 45 min. That should give more maltose, and should give the beer with the high final level degree of fermentation (till 72 %). Needs to say that there is longer period of malt fermentation in CC-Tanks (V = 1t) from 7 to 10 days, the after-fermentation process will be more than one month.

These data highlight the beer «Lustdorf» as the best of the samples, which agree with the results of sensory evaluation (Table. 2), carried out using 25-mark grade.

Table 2 – Mark grade of beer quality

Beer variety	Beer quality level						Total mark, poits	5-mark grade
	Clarity	Color	Aroma	Taste		Foaming		
				Palate fullness	Hop bitterness			
Beer «BERNARD»	3	2	3	4	4	4	20	Good
Beer Chernigivs'ke «BILA NICH»	2	3	3	4	5	5	22	Excellent
Non-pasteurized beer. «LUSTDORF»	2	3	4	5	5	5	24	Excellent

Using ranking point system is inconvenient for perception because there are different grades for evaluating the organoleptic characteristics. Thus, for evaluation of transparency and color used 3-mark grade, for evaluating flavor - 4-mark grade, whereas for the other indicators – 5-mark grade.

The results obtained by using the profile method, provide a more complete picture of the organoleptic properties of beer than the results mark grade method. Thus, the mark grade method will not allow to visualize the combination of features properties of the finished beverage [6].

The acidity of the beer samples (Table 3), which was made in the laboratory, is limited by regulation of normative documentation USS 3888-2015 «Beer. General specifications», and is also consistent with the data of sensory research.

Flavor evaluation is the most difficult process because it includes a complex concept. That means taste, flavor and texture feeling, defined in the oral cavity. The reliability of determination the organoleptic indexes of "body" can be confirmed by the results of rheological studies (Table. 3). They show the highest viscosity and density of the beer sample of trademark Lyustdorf [4].

Table 3 – Quality figures of dark beer

Figures	Beer «BERNARD»	Beer Chernigivs'ke «BILA NICH»	Non-pasteurized beer «LUSTDORF»	Requirements of normative documentations USS 3888-2015
Density, g/cm³	1,011	1,010	1,014	Not-rationed
Viscosity, Pa*s	$1{,}3842*10^{-3}$	$1{,}6155*10^{-3}$	$1{,}7390*10^{-3}$	
Acidity, cm^3 1 mol/dm^3 solution of Sodium hydroxide for 100 $см^3$ of beer	2,4	2,2	2,1	2,1-3,3

Conclusions

The profile method for evaluation can be recommended for deep analysis of beer organoleptic properties. A correlation was established between individual physicochemical and organoleptic parameters of the quality of dark beer. To build a profile of the beer flavor is advisable to use the following terms: characteristic, body, bitterness, hops bitterness, acidic, sweet, malt, harmonic, rude, yeasty, caramel, fruity and residual bitterness.

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ИСПОЛЬЗОВАНИЕ ПРОФИЛЬНОГО МЕТОДА ПРИ ОЦЕНИВАНИИ КАЧЕСТВА ПИВА

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Аннотация. Установлена целесообразность использования профильного метода анализа для оценки влияния технологических факторов на формирование качества пива. Выбраны характеристики для проведения оценки качества пива профильным методом. Результаты, полученные при использовании профильного метода, дают более полное представление об особенностях свойств пива, чем результаты баллового метода. Каждый из образцов был проанализирован и изучен. Результаты анализа таких критериев, как аромат, флейвор, внешний вид и физико-химические показатели продемонстрированы на профилограммах. Оценивание флейвора является наиболее сложным, так как это понятие включает комплексное ощущение вкуса, аромата и консистенции, определяемое в ротовой полости. Для подтверждения органолептических свойств «тела» наилучшего сорта пива были приведены данные реологического анализа. Такой комплексный подход позволит полностью изучить свойства слабоалкогольного напитка и наглядно продемонстрировать преимущества профильного метода анализа.

Ключевые слова: пиво, качество, профильный метод, органолептический анализ.

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