Improved Beer Production Technology Using Unmated Raw Materials Obtained From Jerusalem

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ABSTRACT

The article discusses an improved technology for the production of non-alcoholic beer using unmalted raw materials obtained from non-traditional Jerusalem artichoke raw materials. The author's work using new technology has produced products such as powder, concentrate, and syrup from the tuber part of Jerusalem artichoke, cultivated in Uzbekistan. These products were used in the preparation of beer. The main task of adding pre-prepared Jerusalem artichoke powders to the wort is to obtain different types of beer (also for dark and light), which will contain active natural values due to the enrichment of beer with native substances, including inulin, trace elements and other substances.

Keywords: Classic brewing method, mash, cooking with hops, Jerusalem artichoke powder, non-traditional raw materials, unmalted raw materials, inulin, proteins

Introduction.

The technological process of producing beer using the classical method at the plant consists of several technological processes. These processes include the process of water preparation, which plays a special role in the preparation of drinks, then the key process in the technology is the preparation of beer (boiling with hops), adding yeast, fermentation of hopped beer wort, as well as post-fermentation of hopped beer wort and, of course, beer filtration. Filling, capping of the finished product, pasteurization, decoration and transfer of the finished product to the warehouse are the final processes in the technology of beer production.

First of all, the water is prepared; this process is carried out carefully; the quality and taste of the finished product depends on the quality of the water. To do this, water is mainly carried out in factories, that is, it is prepared using water treatment equipment, which must meet the requirements of the instructions. When the pH of the mash is too high, which is often due to the presence of carbonate hardness in the mashing water, the mash is acidified with lactic, phosphoric or other acids. Microbiological and organoleptic analyzes are carried out for water preparation.

According to traditional technology, to obtain beer wort, a single-decoction mashing method is used in two stages. The malt is crushed in a 6 roller crusher until ground. The raw materials are crushed, but not kneaded, leaving crushed fractions of different sizes. Then water is added, the mashing process is carried out, to speed up fermentation, the mash is heated to +73 ^{o} C. The finished wort is transferred to a filtration tank for filtration, then the beer wort is brought to a boil, and hops are added. Add hops in three portions. To do this, divide the intended portion according to the recipe into equal three parts, add the first part at the beginning of cooking, the second part after an hour, and the third part until 30 minutes after the end of cooking the hopped wort. Beer

wort is boiled during hopping for 150 minutes, during which enzymes are destroyed, and at the same time the beer is sterilized, in this process all chemical reactions stop. Afterwards, the finished wort is filtered and infused to remove heavy particles for unfiltered substances.

Main fermentation and prolonged fermentation of beer wort. The wort, after undergoing the clarification process in a settling tank, is cooled within a temperature range of 8º C - 9° C, after which it is transferred to the CCT for fermentation of the beer wort. The CCT is filled to 80-85% of the geometric capacity (not completely). Yeast of the so-called strain Strain 8A AM is added to the first portion of beer wort, which enters the CCT; the portions of yeast are determined from the ratio of 0.5-0.7 l/hl per beer wort . The fermentation process is considered to have begun if a thick layer of foam appears on the surface of the wort. In this process, sugar is converted into alcohol and carbon dioxide by yeast.

During the fermentation of beer wort, the temperature inside the CCT increases. The process of alcoholic fermentation of carbohydrates contributes to this increase in thermal energy. The temperature of the wort rises to 12-14° C and is maintained within these limits until the end of fermentation for two days. At this time, the laboratory determines several times the content of dry substances in the beer wort. After the dry matter in the wort reaches 3.0-5.0%, the CCT is tongue-and-groove. Further, the introduction of subsequent processes at a pressure of 0.03-0.08 MPa will ensure better saturation of beer with carbon dioxide and accelerate the process of yeast sedimentation. The end of fermentation is determined when the reduction in beer content in the conical part of the tank stops, then the process of cooling the young beer occurs, while it is cooled to the maximum temperature from + 1 ° C to + 2 ° C within 48 hours, after cooling the refrigerant supply is immediately stopped. The temperature of the beer wort located in the conical part of the tank is maintained at 12° C - 14° C for up to 48 hours, while the main goal is to accelerate the maturation of beer. As a result of fermentation of beer wort, unfiltered beer is obtained, which requires maturation. Next, the refrigerant is supplied to all parts of the CCT jacket, except for the conical part of the CCT. Cooling of the beer wort is continued until the temperature of the entire mass of beer drops to 0 - 1 ° C. In this case, the sheet pile pressure is maintained at 0.03 - 0.04 MPa. Next, the removal of yeast begins, while the first removal of yeast is released from the fitting of the conical part of the CCT. After removing the wort, it should be clarified; before serving the beer to settling tanks, you need to carry out a second yeast removal. When the yeast is first removed, the first portion and the final portion are lowered into a container for commercial yeast, and the middle layer is lowered into a container for seed yeast, where all the yeast is washed with cold water (1° C - 2° C), and after washing it is filled with cold water. After the second removal of yeast from the CCT, the beer is transferred to settling tanks. Fermented beer wort is clarified in settling tanks (filtration and separation). When carrying out the initial fermentation and the second fermentation, that is, post-fermentation of young beer in the CCT, the total duration of these processes should not exceed 12 days.

Filtration of young beer is a key final technological process. In this process, the beer is separated from the remaining yeast grounds, and the shelf life of the finished product - the drink - is ensured. In carrying out beer filtration, it is necessary to follow the mandatory technological instructions, the CCT in which the beer is transferred for filtration, connecting it to a line of purified compressed air to create the necessary back pressure in it. The filtered beer arrives in a collection tank. The collections are installed in a refrigerated room. After the beer has entered the collections, it is kept in it for 3 to 8 hours and at a uniform pressure of 0.4 kgf/ms ^{3} . In case of loss of gas or a small amount of carbon dioxide, artificial carbonation of the beer is carried out.

After all the particles have been filtered, the beer is poured into barrels, cans, glass or plastic containers, into kegs and, if necessary, the finished product is pasteurized. Before bottling, air is removed from the container and thoroughly washed with special solutions to ensure maximum sterility and cleanliness of the

container. Beer bottling is carried out in accordance with GOST 31711-2012; UzTR .71-012:2017. Capping is done with crown stoppers according to TU Uz 64-15862776-01. After capping, beer bottles are subjected to visual inspection on a light screen for inclusions, contamination and transparency. Pasteurization of bottled beer is carried out in tunnel pasteurizers, which provide temperature changes in separate zones through which bottles of beer are passed. Beer bottles are decorated with labels, necklaces, and back labels. The information on the label (marking) must comply with the requirements of the General Technical Regulations UzTR .71-012:2017, UzTR .490: 2017.

Object and methods of research.

Ready-made inulin powders from Jerusalem artichoke of local Uzbek varieties "Muzhiza" and "Fayz-Baraka" were studied in the laboratory of a production plant on various beer technology processes:

- after crushing the malt, in the mash tun, when boiling malt and water, Jerusalem artichoke powder was added to the mash tun along with the malt;

- in the process of boiling the wort together with malt, part of the malt was replaced (5%; 10%; 15%; 20%; 30%) with Jerusalem artichoke powder; at the end of boiling beer wort with Jerusalem artichoke powder;

- also during the process of boiling the hopped wort, Jerusalem artichoke powder was added. The powder was added along with hops at the beginning of boiling, or after an hour of boiling, or before 30 minutes of the end of boiling;

- at the beginning of the main fermentation of the wort, diluted yeast, stirring continuously, adding with inulin powders from Jerusalem artichoke;

- at the end of fermentation of the wort together with inulin powders from Jerusalem artichoke;

Industrial testing. The preparation of raw material components, including the process of preparing beer using the classical method using light and dark methods, was carried out in accordance with the accepted traditional technology of the plant.

Experiments carried out at the plant: Experiments were carried out on the introduction of inulin powder obtained from local varieties of Jerusalem artichoke, two samples which are further referred to as No. 1 (Muzhiza), No. 2 (Fayz-Baraka). Powders were added at several technological stages of preparing light and dark beer. The following stages of adding inulin powder were selected by variety, in such stages as the brewing of crushed malt, the mashing process of raw materials, the technological process for preparing beer wort, preparing hopped wort, the fermentation process, first and secondary fermentation.

Results and discussion.

The main task of adding pre-prepared Jerusalem artichoke powders to the wort is to obtain different types of beer (also for dark and light), which will contain active natural values due to the enrichment of beer with native substances, including inulin, trace elements and other substances in which found in Jerusalem artichoke powder. In this proposed technology, unmalted agricultural non-traditional natural additives were successfully used in beer production along with the main components malt, wheat, and barley. Inulin powder obtained from Jerusalem artichoke tubers was used as a replacement for unmalted raw materials (malting barley, wheat) up to 30%.

% ratio of powder	Malt	Powder
5%	173 kg	7 kg
10%	166 kg	14 kg
15%	159 kg	21 kg
20%	152 kg	28 kg
thirty%	138 kg	42 kg

Adding powder to mash crushed malt with water: during the wort boiling process, it was completely carried out according to the factory technology described above. The single-brew mashing method from a full batch of brewing malt was replaced by 5%, 10%, 15%, 20%, 30% Jerusalem artichoke powder with a moisture content of 6%, 8% and 10%. The powder was introduced at the above stages in technological processes together with malt.

Temperature and duration of the mashing and boiling process.

Table 1

No.	Temperature, ◦ C.	Protein break, min.	Heating temperature, ◦ C.	Maltose pause, min.
1	42	20	up to 52	thirty
2	63	thirty	up to 70	25-30
3	The temperature rises to 77 ◦ C and By maintaining this temperature the mash is filtered.			
4	Beer wort is brewed for 1 hour 30 minutes			

The beer wort is brewed for 1 hour 30 minutes, during which the spent grains are washed, and the wort is also hopped using classic plant technology. At the end of cooking, the density of the initial wort and the quantity were determined, which was 12% total density; 10 ch.

Stages of powder introduction and their ratios

table 2

Jerusalem artichoke powder, (humidity, 100%)	Stages of powder introduction	Powder to malt ratios
Sample No. 1(5.0%)	Mashing malt	1/20
Sample No. 2 (7.0%)	Boiling wort (with hops)	1/10
Sample No. 1 (10%)	Mashing malt (boiling wort)	1/15
Sample No. 2 (8%)	End of cooking	1/12
Sample No. 1 (10%)	Fermentation	1/18
Sample No. 2 (8%)	Fermentation	1/16

Experimental data of the obtained beer samples

Table 3

Names of indicators	Control 100% malt	Sample No. 1	Sample No. 2
Initial wort extractivity, %	11.2	11.0	12
Ethyl alcohol content, vol.%	4.0	4.4	5.0
Carbon dioxide content, wt .%	0.33	0.33	0.33
Visible degree of fermentation, %	81.0	81.8	83
Beer persistence, days	1	1	1

The duration of the main fermentation was 7 days, the temperature in the tank was kept in the region of 8-10 ◦ C. During the duration of the process of fermentation of the initial wort, the density of the wort was constantly determined. When the density was 4%, the second fermentation began, that is, post-fermentation of the wort, the temperature was reduced to 2 ◦ C. The total duration of beer fermentation was 21 days. After the fermentation process is completed, the fully fermented beer is filtered and transferred to the bottling of the finished product. Table 2 shows tested options for adding Jerusalem artichoke powders in various beer brewing processes.

Conclusion.

From Table 3, it is clear that the resulting sample No. 1 in terms of indicators does not differ from the control sample with the resulting 100% malt, since sample No. 1 has some differences in the ethyl alcohol content of almost 1.0 degrees from the control, which contributes to a higher carbohydrate content Jerusalem artichoke. At the same time, the component composition is improved due to the native properties of polysaccharides of inulin nature in combination with nutrients and biologically active components, which ensures the production of products with positive qualities.

In this proposed technology, unmalted agricultural non-traditional natural additives were successfully used in beer production along with the main components malt, wheat, and barley. Inulin powder obtained from Jerusalem artichoke tuber was used as a replacement for unmalted raw materials (malting barley, wheat) up to 30%.

References

1. Рустамбекова Ф.Ф., Бобоев А.Х. Свойства пектина из концентрата топинамбура, полученного по инновационной технологии. // Universum технические науки. - 2019.№2(59). (02.00.00. №1).
2. Рустамбекова Ф.Ф. Ноанъанавий қишлоқ хўжалиги хом ашёси топинамбурдан фойдаланиш йўли билан пиво технологиясини такомиллаштириш [Improvement of brewing technology by using non-traditional agricultural raw materials topinambur]. aftoreferat, TKTI. 2021.
3. Рустамбекова Ф.Ф. Изучения химического состава концентрата топинамбура. Journal of new century innovations. 2023. 21/4. –С. 100-109.
4. Ogneva A. N. Razrabotka tekhnologiy fruktovo-ovoshchnykh produktov bifodogennymi svoystvami. Diss. dok. tekh. nauk [Development of technologies of fruit and vegetable products with bi-pathogenic properties. Dr. tech. sci. diss.]. Krasnodar, 2015. 159 p.
5. F.F.Rustambekova. IMPROVEMENT OF BREWING WITH THE USE OF UNCONVENTIONAL RAW MATERIALS. Technical science and innovation. 2022. 1/11. pp.34-38 .
6. Абдуразакова С.Х., Рахманбердиева Р.К., Хакимова Ш.И., Абдуллаев У.К., Таджибаева Ф.Ф. (Рустамбекова Ф.Ф.). Топинамбур туганагидан табиий шарбат ва сироп олиш усули. Ихтирога патент № IAP 05312. Ўзбекистон Республикаси интелектуал мулк агентлиги. ТКТИ. Uz 30.11.2011 й