Improvement of technology of low-calorie diet beer

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Abstract

The technology of low-calorie diet beer using inulin-containing raw materials of plant origin, namely chicory root, is researched. For the preparation of low-calorie diet beer, it is proposed to introduce into the malt mash at the beginning of the rubbing of an aqueous extract of chicory obtained by extraction of water-soluble substances of crushed dried at a temperature of 80 °C to a moisture content of 12–14% of root vegetables, in the amount of 3–10% by weight of malt, in the ratio of water 1:(4–7), temperature 70–80 °C for 40–60 min and enzyme preparation inulinase. The resulting mash is then kept at 55–56 °C for 20–30 min until complete hydrolysis of inulin. The introduction of bitter chicory in the wort allows to reduce the expense of bitter hops by 25–30% compared with traditional methods and to increase the stability of beer to 90 days without pasteurization. Substitution of chicory malt makes it possible to obtain new varieties of high biological value beer by enriching the product with inulin, trace elements and other biologically active compounds of vegetable raw materials, reducing the content of dextrins, reducing carbohydrates and energy in the finished product. fermentation of beer wort, as well as increase the value of the bread.

Keywords: *chicory, mash, wort, beer, inulin, aqueous extract, hops.*

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DOI: 10.24263/RES-2019-9

Introduction

Consumers who are forced to consume low-calorie foods have increased their interest in dietary and diabetic beers [1, 8, 9]. In such varieties of beer the content of carbohydrates (glucose, sucrose, maltose, low molecular weight dextrins, starch and products of its hydrolysis), alcohol, as well as the caloric content of the product are limited. The production of low-calorie beer is possible provided that the beer wort is cooked with the maximum content of fermented substances [11]. The degree of digestion of low-calorie beer reaches 80–90%. For its preparation as unsweetened raw materials use vegetable raw materials therapeutic and prophylactic action, enriched with carbohydrates, which are easily absorbed by the human body. Diet beer is low in dextrins, reducing carbohydrates, low energy (calorie) and nutritional value (in carbohydrates) [3–5].

The aim of research is improvement of the low-calorie diet beer by increasing the degree of fermentation of wort carbohydrates, biological value and stability of beer during storage through the enrichment of the components of fresh inulin-containing raw materials that are easily absorbed by diabetics, and bitter nutrients.

Materials and methods

Research methods – analytical, chemical, physico-chemical, using instruments and research methods used in beer production.

Analysis of aqueous extracts of dried and roasted chicory, beer wort and beer was performed according to traditional methods [4].

Results and discussions

The main raw material for the preparation of wort is soluble malt with high amylolytic activity and protein content of up to 10%. Known methods for the production of diet beer include increasing the consumption of hops by 40–50% to cover the empty taste of beer, which is a consequence of deep digestion of carbohydrates, which leads to an increase in the cost of beer [4, 5, 7].

One way of expanding the range and preparation of low-calorie diet beer is the use of inulin-containing raw materials of plant origin, which helps to reduce blood sugar, normalize metabolism, improve the immunological status of the organism, remove from it slag, toxins and other substances. Inulin-containing raw materials include chicory, Jerusalem artichoke, dahlia, burdock, medicinal dandelion, etc. The most promising raw material for beer production is chicory and Jerusalem artichoke. The most valuable component of chicory and Jerusalem artichoke is inulin, a polysaccharide that has therapeutic and prophylactic properties and, unlike starch, is readily absorbed by diabetics. Its content in fresh root crops is 60.8–65.0%, in dried root crops – 51.7–59.7%, in dried – 25.9–28.0% on dry matter (DM). Inulin has low calories. In its presence, the shelf life of the food is increased. The final product of inulin hydrolysis is fructose, which is not harmful to diabetic patients. Along with pure inulin, chicory contains a significant amount of inulides (fructose polymers with less polymerization), pectin, cellulose, organic acids, amino nitrogen, amino acids, vitamins, macro- and microelements, as well as valuable bitter substances (glycosidic, ataraxatol, etc.). The concentration of bitter substances in fresh roots is 0.18–0.32% on DM, bitterness index is 1:600 [2–4, 6, 7].

Known methods of preparation of light and dark beer include the introduction into the beer wort of aqueous extracts of potatoes or aerial parts of Jerusalem artichoke, dry powders with a moisture content of not more than 14% relative to malt from 1:100 to

1:16 based on DM, concentrated aqueous extract. chicory in the amount of 2...7% or crushed dried root vegetables in the amount of 4...10% by weight of grain products, adding to the porridge enzyme preparation «Diazim X4» and others [1, 5, 6]. Their use makes it possible to obtain new varieties of high biological value beer by enriching the product with inulin, trace elements and other biologically active compounds of vegetable raw materials, reducing dextrins, reducing carbohydrates in the finished product, reducing nutritional content and energy.

The main disadvantages of these methods are the increase in the cost of beer due to the increase in the cost of expensive hops due to the absence of bitter substances in the composition of Jerusalem artichoke roots and their low content in concentrated aqueous chicory extracts. In addition, the use of an aqueous extract of roasted chicory for the preparation of dark beer leads to a decrease in the content of amine nitrogen, vitamins, pectic substances, fibers and water-soluble carbohydrates due to their loss during roasting of roots at high temperatures. The absence of a temperature break, which is optimal for the action of the inulinase enzyme, reduces the degree of fermentation of the wort.

To solve this problem, it is proposed (patent of Ukraine according to the invention № 115398) to apply malt puree at the beginning of puree from an aqueous extract of chicory obtained by extraction of water-soluble substances, crushed dried at 80 °C to a moisture content of 12–14% of root crops, in the amount of 3–10% by weight of malt, in a ratio of water 1: (4–7), temperature 70–80 °C for 40–60 min, and the enzyme preparation inulinase, maintain the paste at a temperature of 55– 56 °C for 20–30 min until complete hydrolysis of inulin. This method eliminates the negative effects of high temperatures to preserve bitter chicory.

A temperature of 55–56 °C is optimal for the enulinase enzyme. Within 20– 30 min, inulinase completely hydrolyzes inulin to fermented carbohydrates, thereby increasing the degree of digestion of diet beer and reducing its caloric content [4].

As can be seen from the table, the use of dried chicory root can additionally enrich the beer wort with valuable biologically active substances and increase the feed value of the pellets due to the increased chicory pectin content.

In the extract obtained from dried root crops, the content of inulin is 48% higher than its concentration in the extract obtained from fried chicory, the content of alcohol-soluble carbohydrates – by 35%, the protein – by 320 times, the protein – by 30%, the concentration of amino acids – in 30 times. But the active acidity of the aqueous extract coincides with the acidity of the cluster of malt and is optimal for the hydrolysis of starch. Amine nitrogen and amino acids introduced into the chicory wort are the nutrition source of the yeast. The introduction of bitter chicory bridges helps to reduce the consumption of bitter hops by 25–30% compared to traditional methods and increase the stability of beer.

To prepare the extract, dried chicory in the amount of 3–10% Bx. The grains are poured into the extractor, mixed with water in a ratio of 1:(4–7) and maintained at 70–80 °C for 40–60 min. The hydraulic module is calculated depending on the desired DM concentration in the starting wort.

Table 1

Comparative characteristics of the physical and chemical parameters of aqueous extracts of dried and roasted chicory

Name of the indicator	Aqueous extract of chicory	
	dried	fried
Content: DM,%	15,2	17,1
inulin,% in terms of DM	54,5	28,0
alcohol-soluble carbohydrates,% in terms of DM	24,7	19,0
pectic substances,% in terms of DM	1,0	0,42
total nitrogen, g /100 g of extract	1,012	0,845
of amine nitrogen, mg /100 g of extract	409,3	13,4
protein, g /100 g of extract	6,47	5,28
aminoacids, g /100 g of extract	2,35	0,084
Active acidity (pH)	5,3	4,3
Titrated acidity, deg	0,5	0,9

At temperatures below 70 °C, the solubility of inulin decreases, its intensity is extracted, and favorable conditions for the development of microorganisms are created. At temperatures in excess of 80 °C, the chicory bitters are destroyed, the consumption of sugars and amino acids for the formation of melanoidins increases. It is established that the maximum extraction of water-soluble chicory substances is reached in 40–60 min.

The method of preparation of low-calorie diet beer is as follows. For protein hydrolysis, light brewed malt is ground and mixed with water at a temperature of 45–47 °C in a ratio of 1:(4–5) in a mash machine and kept for 20–30 min with constant stirring. When mixing aqueous chicory extract with malt congestion, the temperature of the mixture is raised to 55...56 °C. At this temperature, the enzyme preparation of inulinase (for example, «Xyloglucanophoidin P10X» in the amount of 0.6–0.9% by weight of chicory, «Fructozume 1», «Aspergillius awamori 2250», «Diazim X4» or other hydrolytic enzymes, is introduced into the mash. hydrolyzing polyfructans – inulin). At this temperature, the inulinase enzyme has maximum activity. After holding for 20–30 min, the congestion temperature is raised to 63 °C to continue enzymatic hydrolysis of inulin, maltose and malt starch. The mash was maintained for 30 min,

after which the temperature was adjusted to 70 ° C. The paste is maintained until the starch and inulin are completely saccharified. Then the saccharified mash is heated to a temperature of 76 °C and filtered. The resulting wort is boiled with hops, clarified and pumped into the fermentation shop. With boiling wort, the expense of bitter hops is reduced from 20 to 14–16 g/dal.

The beer samples obtained were characterized by a rich malt taste with hop bitterness and a pure hop aroma with pleasant tones of rye bread. Due to the high content of alcohol and bitter substances of chicory, the shelf life of beer was increased to 90 days.

Conclusion

For the preparation of low-calorie diet beer as unsweetened raw material, it is advisable to use fresh or dried to humidity 14% chicory root. The proposed method allows to reduce the cost of hops by 20–30% compared to the known ones. The introduction of the enulinase enzyme preparation and holding the congestion at a temperature of 55–56 °C for 20–30 min before complete hydrolysis of the inulin polysaccharide allows to increase the degree of beer fermentation to 90%. Obtained low-calorie diet beer in terms of organoleptic and physicochemical parameters fully comply with the current standards requirements.

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