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DEGRADATION OF PECTIN AND STARCH IN SWEET SORGHUM STEM JUICE USING ENZYMES

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Abstract: The article examines the chemical properties of sweet sorghum stem juice. Given the high carbohydrate content in the juice, the aim of the study is to break down the polysaccharides it contains into glucose. The fermentation methods for starch and pectin substances present in the juice are described, using a high-concentration amylolytic enzyme preparation - liquid amylase Fructamyl HT-300, as well as a high-concentration pectolytic enzyme preparation - liquid pectinase Fructazyme P-XL.

Keywords: sweet sorghum, stem juice, chemical composition, result, pectin, amylase, starch, pectinase, hydrolysis.

Introduction. The production of food products such as sugar corn stalk juice concentrate, potoka and liquid honey is increasing and their range is expanding.

Corn syrup is heat-stable, so it can be added to drinks, used in baking, and even made into fudge or caramel. It is a natural and safe substitute for refined sugar and sugar syrup.

The valuable biological property of the sugarcane plant is limited by soil moisture and precipitation, and it has been found that it has the ability to accumulate sugars even in high temperature conditions. During the ripening period, the stalk of the sugarcane plant contains approximately 80-90% juice, and up to 10-29% sugars.

Since 2012-2013, sugar beet pulp has been offered in Kazakhstan as a raw material for the production of syrup, sugar syrup, and sugar products [1; 2; 3.].

When comparing the chemical composition of sugarcane juice with that of starchy raw materials, it was found that the juice had a lower content of titratable acids and a higher content of sugar.

Sugarcane juice contains only sucrose (crystallizing sugar), while sugar corn juice contains glucose and soluble starch, which prevent crystallization, in addition to sucrose.

This property of sugar corgum stem juice can serve to partially reduce the crystallization properties of the honey product of bee families fed with juice-based feed.

Due to this feature of sugar corn, the need to use juice with increased dry matter content for various purposes is increasing, especially in the food industry [3; 4.].

Sugar corgum juice mainly contains sucrose and other carbohydrates, fiber, starch, pectin substances, partially protein and a small amount of fat [4.].

It is known that from a physiological point of view, fruit, vegetable, and herbal juices are among the most nutritious juices. They are composed mostly of water, along with various biological elements.

Juices not only satisfy the body's need for water, but also provide energy to a dehydrated body by absorbing up to 96-98 % of its energy due to the presence of glucose and fructose.

Nowadays, technologies for extracting juice from unusual but very useful plants are being studied in our Republic.

The process of extracting juice from plant components is considered complex, and the final stages of using the extracted juice are applied to the production of food and alcoholic beverages [5].

According to the purpose of the selected research work, the chemical composition of the juice was analyzed in order to develop technologies for the preparation of bee feed from sugar corn juice concentrate.

Plants contain up to 70-80% juice, depending on their species. In some plants, the juice is mainly collected in their stems.

For example, during the wax ripening period of plants such as bamboo, sugarcane, and sugarcane, the waxy pulp of plants is characterized by the accumulation of a sap rich in fructose, glucose, and sucrose, as well as vitamins and minerals [6.].

In our country, little research has been conducted on the extraction of juice from the stem parts of plants and the use of processed products in food and other industries.

The main objective of the research is to extract juice from the stem of sugarcane and to study its processing as bee food, and for this it is necessary to analyze the methods of extracting juice from the stem of plants.

The varieties of sweet corn selected for the study, which are considered to have a high sugar content, are “Qorabosh”, “Orangevoe-160”, and “Uzbekistan 18”. The dry matter content is on average 18-23 %, and the juice content in the stalk is up to 70-80% [6; 7].

In addition to carbohydrates such as glucose, fructose and sucrose, the presence of starch and pectin substances in sugarcane stalk juice was determined using iodine test and alcohol test methods.

Method for determining the amount of starch in juice [9.] The presence of starch in juice can be determined by heating the juice to 90÷100 °C and gelatinizing the precipitate.

To do this, pour 1 ml of iodine solution into 10 ml of the juice being tested in a beaker and mix thoroughly. To prepare the iodine solution, 1 g of iodine is diluted in 20 ml of ethanol, 20 g of potassium iodide is added, and the solution is diluted with 1000 ml of distilled water.

The initial jelly-like appearance of the juice and the resulting yellowish-blue color indicate that it contains undigested starch. During the experiment, the orange color of the juice indicates that the starch has been broken down into glucose. The breakdown of starch into glucose increases the sugar level of the juice.

The alcohol test method was used to determine the presence of pectin in the juice 5 ml of the test sample is poured into a beaker, 10 ml of ethanol (96% ethyl alcohol) is added, shaken vigorously, and the duration of pectin decomposition is determined using a chronometer. Within one minute, no pectin fragments should be visible in the juice.

If the juice does not foam within 24 hours after the addition of alcohol, it indicates that the pectin has been completely broken down. If a precipitate appears at the bottom of the juice sample, the juice needs to be broken down with the enzyme pectinase.

The results of determining the presence of pectin and starch in the juice

These enzyme preparations were used depending on the type and enzymatic character of the research sample, as well as the temperature and reaction time. The analysis was conducted at a temperature of 35÷45 °C for 45÷60 minutes. The iodometry method and alcohol test were repeated to control starch and pectin degradation. As a result, it was observed that starch and pectin were broken down to the glucose phase.

After fermentation, it was found that the juice contained 19-22% of sugars.

After the fermentation process, the juice was condensed to 48-50% under vacuum conditions at 0.94 kPa. Then the content of carbohydrates (sugars) was determined by YuSSX (high performance liquid chromatography) in a diode array detector. The amount of carbohydrates (sugars) in the juice was 46.48% in the "Orangevoe 160" variety, 46.02% in the "Qorabosh" variety, and 47.43% in the "Uzbekistan 18" variety (Table 1).

Table 1. The amount of carbohydrates in condensed sugar sorghum juice

Varieties of sugar sorgum	Amount of carbohydrates (sugars), mg %	
Orangevoe-160	Fruktose	5,48
	Glukose	11,18
	Sucrose	28,12
	Maltose	1,71
	Total	**46,48**
Qorabosh	Fruktose	5,411
	Glukose	11,33
	Sucrose	27,59
	Maltose	1,69
	Total	**46,02**
Uzbekistan 18	Fruktose	6,98
	Glukose	12,24
	Sucrose	26,91
	Maltose	1,57
	Total	**47,43**

Typically, bee colonies are fed mainly with traditional sugar syrup during the off-season.

It was argued that the amount of water-soluble sugars in the concentrated syrup is of essential value for preparing food for the bee colony. As is known, the sugar content consists of up to 96-98% sucrose, and the syrup is not enriched with additional vitamins, minerals and amino acids. In addition to sucrose, condensed syrup contains carbohydrates such as glucose, fructose, maltose, raffinose, water-soluble vitamins, micro- and macroelements and amino acids.

Conclusion. It was observed that sugar content increased after fermentation of starch and pectin content of sugar corn stem juice. The juice was condensed to 48-50%

under vacuum conditions, the concentration of the juice was increased, and it was proved that it can be a natural, mineral and vitamin-rich, local and low-cost concentrate.

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