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Determination of microbiological and physicochemical characteristicsof sweet sorghum and wort on its base in the non-alcoholic drinks technology

Introduction. Nowadays, an important nutrition problem is the lack in the human ration of vitamins and certain trace elements, which causes metabolic processes disorders and, consequently, leads to the development of pathologies [1].

Non-alcoholic beverages may become a valuable element of healthy nutrition. Since they contain a wide range of carbohydrates, organic acids, mineral substances, vitamins and other biologically active components, due to which they perform restorative effect on human body [2].

Drinks market analysts have already predicted the shift of consumer preferences to products that have a positive impact on health due to nutrients and functional elements content. Despite the economy instability healthy drinks market continues to grow [3].

One of the main conditions for non-alcoholic beverages production is the achievement in them the highest possible nutritional and biological value level through the use of natural plant raw materials[4]. In this study as such raw material was proposed to use sweet sorghum juice, which containsa large amount of biologically active substances, including vitamins, micro- and macroelements. During the research was also considered the possibility of apple juice concentrate use in the health beverages technology, which will expand the range and provide high consumer properties of such drinks.

Purpose of the work was to study microbiological and physicochemical characteristics of sweet sorghum juice and unpasteurized wort on its base, diluted apple concentrate, mixture of 70 % unpasteurized wort from sweet sorghum juice and 30 % diluted apple concentrate.

Materials and methods

For present purpose achievement in this study as objects of investigation were chosen:

- sweet sorghum juice cultivar Nectarial, obtained by pressing method;
- apple juice concentrate produced by Döhler company (content of dry matter 65±1 %).The preparation of concentrate for the investigation was made by the way of dilution to the dry matter content (DM)of 10 % with sterile bottled water;
- mixture of 70 % unpasteurized wort from sweet sorghum juice and 30 % diluted apple concentrate.

For the purpose of wort from sweet sorghum juice obtaining were used such enzyme preparations (EP):

- enzyme preparationXylolad with temperature optimum45±5^{o}C, which is the source of xylanase;
- enzyme preparationof fungal natureTegamyl FAL with temperature optimum53±2^{o}C, which is the source of α-amylase and glucoamylase.

In the study analysis of microbiological characteristics of the samples was carried out by their dilutions inoculation with the use of such culture media:MPA, MPA with 10% glucose, wort agar, Kessler's, ENDO and MRS. After incubation in thermostatcolonies were counted,defined isolated morphotypes and made a research of their morphologic-cultural and physiologic-biochemical traits.

For the research of morphologic-cultural traits of morphotypes was used microscopy of wet mount preparations. The investigation of physiologic-biochemical traits was carried out by identification of capsule forming bacteria by Burry-Gins method and determination of Gram stain type.

For the purpose of physicochemical characteristics of sweet sorghum juice, unpasteurized wort on its base, mixture of 70 % unpasteurized wort from sweet sorghum juice and 30 % diluted apple concentrate determinationin the study were used modern methods of investigation and commonly used techniques of chemical and technological control of sugar and beer non-alcoholic production[5]. Content of

vitamins in sweet sorghum juice was determined by means of capillary electrophoresis system "Capel-105" with a high voltage source of positive polarity. Recording and processing data obtained was carried out using the software "MultyChrome"[6].

Results

In the study was made physicochemical analysis of sweet sorghum juice and determined its chemical composition. So, content of DM in juice is 18,0±0,2 %, total sugars – 12,7±0,1 г/100 cm^3, reducing substances–2,5±0,1 g/100 cm^3.Total acidity of sweet sorghum juice was1,75±0,1 cm^3 1NNaOHper 100 $см^3$, active acidity (pH) – 5,3±0,1.

Furthermore, was determined content in juice of such main vitamins of B group: B1 – 2,34mg/dm^3, B2 – 1,49 mg/dm^3, B3 – 29,17 mg/dm^3, B6 – 5,05 mg/dm^3, B9 – 0,21 mg/dm^3, Biotin (B7) – 0,42 mg/dm^3, Cholin(B_p) – 186 mg/dm^3.

Considering that apple concentrate and sweet sorghum juice are microbialy contaminated, it is necessary to analyze the impact of their microfloraon microbial contamination of obtainedwort.

Quantitative content of detected microflora is performed at table 1.

After analysis of morphologic-cultural and physiologic-biochemical traits of morphotypes isolated from sweet sorghum juice, identified bacteria by the majority of traits can be referred to *Lactococcus*, *Streptococcus*and *Bacillus* genera. Also there were detected yeasts of *Sacharomyces*and*Rhodotorula*genera.

Microflora of diluted apple concentrate was performed with three morphotypes of cells, whichby the majority of morphologic-cultural and physiologic-biochemical traits can be referred to*Lactococcus*, *Streptococcus*and *Saccharomyces*genera.

Table 1

Microflora of sweet sorghum and diluted apple concentrate

№ sample and its characteristics	Lactic acid bacteria	Coliforms	QMAFAnM	Sporeforming bacteria	Yeasts
	presence in 1cm^3		CFU/cm^3		
1 – sweet sorghum juice	+	-	$1,7 \cdot 10^5$	$8,3 \cdot 10^3$	$1,6 \cdot 10^3$

(DM 18 %)					
2 – diluted apple juice concentrate (DM 10 %)	+	-	8,6·10	2,2·10	6,4·10

As shown in the data above, quantitative and qualitative composition of the microflora of diluted apple juice and sweet sorghum juice are slightly different. This difference is explained by differences in the composition of the native microflora of raw materials, methods and periods of harvesting.

Further studies were directed at analyzing quality characteristics of wort prepared from sweet sorghum juice by enzymatic treatment of raw materials and mixtures of 70% wort from sweet sorghum juice and 30% diluted apple concentrate.

Process of enzymatic treatment of sweet sorghum juice was carried out the next way: in a preheated juice with temperature 35°Cwas brought EP Xylolad in the amount of 0,5 dm^3/t of raw material, which corresponds to 1 unit/g of xylase activity.The duration of hydrolysis process was 15-20 minutes at temperature 35±1°C. This technological method facilitates lighting of juice and increases its filtration rate through the hydrolysis of such high-molecular compounds as cellulose and hemicellulose.The next stage of enzymatic treatment of juice consisted in heating of it up to 55°C and bringing in EPTegamyl FAL in the amount of 0,1 dm^3/tof starch, which corresponds to 5,5±0,1 unit/g of α-amylase activity and 1,6±0,1 unit/g of glucoamylase activity.The duration of starch hydrolysis process was 30-35 minutes at temperature 55±1°C.

The obtained wort was filtrated, diluted with sterile bottled waterup to content ofDM 10 %, acidified with citric acid up topH 4,75 and determined quantitative composition of unpasteurized wortmicroflora, and mixture of70 % unpasteurized and unacidifiedwort from sweet sorghum juice and 30 % unpasteurized diluted to 10 % DM apple concentrate (table 2).

Table2

Microflora of unpasteurized wort samples

Sample and its characteristics	Lactic acid bacteria	Coliforms	QMAFAnM	Sporeforming bacteria	Yeasts
	presence in $1cm^3$		CFU/cm^3		
wort from sweet sorghum juice (DM 10 %) with the use of	+	-	$9,8 \cdot 10^4$	$6,3 \cdot 10^3$	$1,4 \cdot 10^3$
mixture of 70 % wort from sweet sorghum juice and 30 % diluted apple juice concentrate (DM 10%)	+	-	$8,4 \cdot 10^4$	$5,9 \cdot 10^3$	$1,2 \cdot 10^3$

The data content of the wort samples shown, that QMAFAnM order of magnitude less than in the initial sample of sweet sorghum juice. The content of sporeforming bacteriaand yeast in magnitude are less than it's content in juice on the average on 20 and 10 % accordingly. These results are explained by the fact of wort filtration, which provides a partial improvements of wort microbiological characteristics.

The analysis of unfiltered wort from sweet sorghum juice showed that most of isolated morphotypes were yeasts, which due to most of morphologic-cultural traits were similar to*Saccharomyces*and*Rhodotorula*genera. In smaller amounts were detected bacterial morphotypes. After analysis of their morphologic-cultural and physiologic-biochemical traits it was revealed that investigated morphotypes due to majority of traits are similar to bacteria of*Lactobacillus*, *Leuconostoc*and *Streptococcus* genera (Fig. 1).

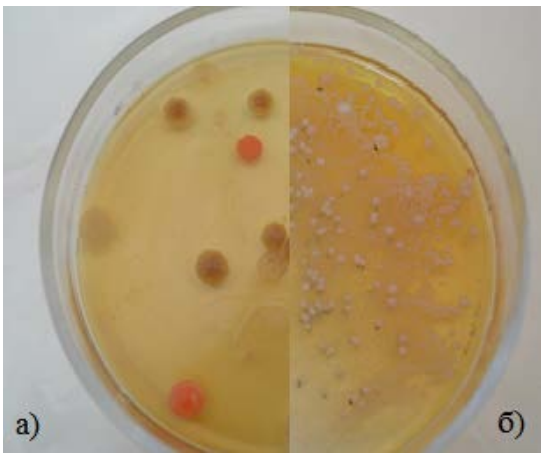

Fig. 1.Micrflora of unfiltered wort from sorghum juice on medium: a) wort-agar, б) MRS

In a mixture of 70 % unpasteurized wort from sweet sorghum juice and 30 % diluted apple concentrate dominating were lactic acid bacteria, which due to most of morphological, cultural and physiologic-biochemical traits were similar to *Lactococcus*genus.

In the study were investigated physicochemical characteristics of unpasteurized wort from sweet sorghum juice and mixture of 70 % unpasteurized unacidifiedwort from sweet sorghum juice and 30 % unpasteurized diluted apple concentrate (table 3).Content of dry matter for both samples was 10 %.

Table 3

Physicochemical properties ofunpasteurizedwortsamples

№ sample and its characteristics	General acidity, cm^3 1NNaOHper 100 cm^3	pH	Total sugars, mg/ 100 cm^3	Reducing substances, mg/ 100 cm^3	Amine nitrogen, mg/ 100 cm^3
1 – wort from sweet sorghum juice	1,75	4,75	8,60	4,05	32,48
2 – mixture of70 % wort from sweet sorghum juice and 30 % diluted apple juice concentrate	1,90	4,57	8,45	3,31	25,71

Investigated samples are characterized with complete composition considering content of dry matter, reducing substances, amine nitrogen, acidity and pH.

Conclusions

As a result of study was identified quantitative and qualitative composition of microflora and basic physicochemical characteristics of sweet sorghum juice, diluted apple concentrate and wort based on them.

Studied samples of wort due to physicochemical characteristics are recommended for further use in the non-alcoholic beverages technology.

Research results show that diluted apple juice concentrate not only increase qualitative properties of wortmicroflora, but contributes to their decline.This decline is due to content of small amount of microorganisms in the diluted concentrate.

In order for further use of unpasteurized wort from sweet sorghum juice and mixture of 70 % unpasteurized and unacidifiedwort from sweet sorghum juice and 30 % diluted apple concentrate in technology of non-alcoholic beverages is recommended their heat treatment for quality and safe products obtaining.

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