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Production of Functional Beverages using Pectin Extracts

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Annotation
As the global population grows, so does the demand for pectin-containing products. This, in turn, requires extracting pectin from fruit and berry production waste generated after juice extraction at processing plants, developing simpler methods for extracting pectin, and applying it in various industries. Currently, the production of functional drinks enriched with pectins for medicinal purposes is increasing, since hydrated pectins have a more effective physiological effect when consumed.

Keywords: extract, pectin, functional, physiological, radioactive, action, metals, pH, concentration, organoleptic, properties, juice drinks.

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Introduction. The main reason for the widespread use of pectin products in various industries (food, pharmaceutical, cosmetics) in recent years is their gelling properties and viscosity. Consequently, demand for pectin is also growing. This, in turn, requires extracting pectin from fruit waste generated after juice extraction at processing plants, developing simple methods for extracting pectin, and applying it in various industries. Pectin was first isolated in 1825 by the French chemist and pharmaceutical scientist Henri Bracanno. It was developed industrially in the 1920s and 1930s. Every year, 40,000 tons of pectin are extracted from citrus fruits, apples, sugar beets, quince, and other fruit pulps, as well as vegetable waste. Pectin is a light-brown, sticky powder with no odor or taste. Pectin is a high-molecular substance belonging to the class of polysaccharides. Pectin substances, along with hemicelluloses, participate in plant metabolic processes, particularly in maintaining fruit firmness, which is crucial for storage. In technically ripe fruits, pectin ensures firmness and turgor. The formation of fruits and the accumulation of sugars, vitamins, pectin and other organic substances in them are greatly influenced by varietal characteristics, as well as nutritional conditions, plant care and especially weather factors [1].

The quantitative composition of pectin substances and the ratio of their fractions are characteristic of each fruit type. Within a species, these parameters vary depending on the variety and environmental conditions. Pectin substances are present in all parts of plants in greater or lesser

quantities. They are distributed throughout various parts of the plant cell and perform a variety of functions [2, 3].

Soluble pectin is found in cellular and vacuolar juice, intercellular tissues and serves as a reserve substance involved in metabolic processes.

Protopectin - pectin cellulose forms the basis of the membrane and is the middle layer, performing the function of a cementing substance that binds cells into a single tissue [4].

The diverse properties of pectin substances allow them to be widely used in the food, medical, and cosmetic industries. Due to environmental degradation, the production of functional beverages for therapeutic and preventative purposes is becoming increasingly important. Currently, the production of functional drinks enriched with pectin products for medicinal purposes is increasing, since hydrated pectin products have a more effective physiological effect when consumed as food [5-7].

It is known that the human body can be exposed to various heavy and radioactive metals, requiring treatment. Aqueous pectin extracts, unlike dry pectin, absorb harmful substances, form insoluble complexes of various forms and remove them from the body [8, 9].

Primary cell wall pectins have a higher degree of esterification than intermediate lamellae pectins. The total pectin content (TPC) and the ratio of protopectin (PP) to soluble pectin (SP) are biochemical characteristics of plant materials. The content of PV, PP, and RVP varies across different types of raw materials. Knowing the fractional content allows us to assess the technological value of pectin-containing raw materials.

Research methodology. Pectin extracts were extracted from pears and apples using acid hydrolysis. Food-grade orthophosphoric acid was used as a pH regulator. The pectin extract was neutralized to pH 7 with calcium carbonate and evaporated to increase the pectin concentration. The pectin substances were then precipitated with 96% ethyl alcohol. The dry matter content of the pectin extract was determined by refractometry according to GOST 5900-73, and the pH was determined by potentiometric analysis according to GOST 8756.16-70.

The prepared pectin extract was added to the juice and the amount of dry matter in the juice was determined by the refractometric method according to GOST 28562-90, titratable acidity by the titrimetric method according to GOST 25555.0-82 and active acidity by the potentiometric method according to GOST 261 88.

Results and discussion. Pear juice is one of the most flavorful juices. Pears are distinguished by their pectin content and high carbohydrate content. The sugar content of pears varies depending on the type and variety, but averages around 10–12%. For example, pears grown in Uzbekistan can contain up to 10.8–12.7% sugar. Their acidity is low, with a pH of 3.5–4.5. The flavor is softer, sweeter, and clearer [10].

Taking into account the juice's properties, a functional drink was developed using pectin extracts obtained from pear waste. The addition of pectin extracts enriches the juice, enhancing its organoleptic properties, increasing its nutritional value, and improving its functional properties.

In order to develop a recipe for a special functional drink that includes pectin extract, we conducted research to determine the optimal ratio of fruit juices and added Tip-Top brand, from the Marvel Juice company. When developing the optimal juice combination, the presence of pectin as a stabilizing additive was taken into account. Using pectin extract as the source of pectin substances, the stability of the juice composition was achieved more quickly. Research was conducted at four concentrations of the module—natural juice: pectin extract—to determine the ratio of juice to pectin extract:

1) Natural juice: pectin extract = 75%:25%;

2) Natural juice: pectin extract = 65%:35%;

3) Natural juice: pectin extract = 40%:60%;

4) Natural juice: pectin extract = 30%:70%.

The experimental results showed that high organoleptic properties were achieved with natural juice:pectin extract ratios of 75%:25% and natural juice:pectin extract ratios of 65%:35%.

Table 1. The influence of pectin concentration on the organoleptic properties of juice.

№	Name of juices	Organoleptic rating of Tip-Top juices from Marvel Juice with added pectin extracts: juice:pectin extract = %:%			
		75:25	65:35	35:65	25:75
1.	Apple juice	10	10	6	3
2.	Pear juice	10	9	5	2
3.	Pineapple juice	10	10	3	3
4.	Orange juice	10	10	3	2

As can be seen from the table, various Tip-Top fruit juices from Marvel Juice, with added pectin extracts in concentrations of 25% - 35%, received optimal ratings based on organoleptic indicators (Table 1).

Further increasing the pectin content in the juice improves its functional properties, but this will increase the cost of the drink, which is economically disadvantageous and reduces its organoleptic properties. The harmonious taste was achieved through an optimal combination of sugar, acid, and formula components in the drinks. The organoleptic characteristics of the resulting beverages are presented in table 2.

Table 2. Organoleptic characteristics of the resulting beverages

Indicator name	Features of functional juice drinks			
	Apple juice based on pear pectin extract	Pear juice based on pear pectin extract	Pineapple juice based on apple pectin extract	Orange juice with apple pectin extract
Appearance and color	The color of the fruit from which the juice is made is characteristic. Transparent.	Light yellow with suspended particles. Transparent.	Light yellow with suspended particles. Transparent.	Orange-yellow color, typical of the color of the fruits from which the juice is made
Taste and aroma	Natural, aromatic, and well-defined. Pleasantly sweet, slightly astringent. No foreign taste or odor.	A fragrant, distinct pear aroma. Pleasant sweet-sour, slightly astringent flavor. No off-flavors or odors.	Very aromatic. Pleasant sweet and sour taste. Slightly astringent. No foreign taste or odor.	The orange aroma is dominant. A very pleasant sweet and sour taste. No foreign taste or odor.
Compatibility	Typical for unfiltered fruit juices, there's a small, hard sediment at the bottom of the container.	A suspension of finely dispersed pulp. There is a small compacted sediment at the bottom of the container.	A suspension of finely dispersed pulp. Some layering is observed.	There are homogeneous suspended particles. Some stratification is observed.
Foreign impurities	No	No	No	No

Sugar not only imparts a sweet taste to the drink but also facilitates the absorption of the aromatic compounds contained in the juice. In our experiments, we used citric acid, which imparts a harmonious tartness to the juice.

As can be seen from the table below, the organoleptic properties of the prepared functional drinks are unique: they are transparent, have a color corresponding to the color of the fruits from which the juice is made, and a natural, aromatic, sweetish taste without foreign impurities.

Conclusion. In conclusion, it should be noted that the following drinks were obtained with the addition of apple and pear pectin extracts: Apple Juice, Pear Juice, Pineapple Juice, and Orange Juice. Unlike dry pectin, aqueous pectin extracts absorb harmful substances, form insoluble complexes of various forms, and eliminate them from the body. Various Tip-Top fruit juices from Marvel Juice, with added pectin extracts at concentrations of 25% to 35%, received optimal ratings for organoleptic properties. The resulting juices, with the addition of pectin extracts, are more functional and beneficial than the original juices, which highlights their value in terms of consumer health.

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