STUDY OF THE RADIOCHEMICAL AND THERMAL CONVERSIONS MECHANISM IN PRODUCTS OF PROCESSING OF GRAPES

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The extraction of biologically active substance was carried out with help of combination of the physical factors: various conditions of temperature (40, 50, 60ºC) and pressure of vacuum drying (8, 14, 16 mm Hg), and also various radiation doses by electrons with energy 12 MeV (10, 20, 40 kGy). The investigations of dynamics of definition of extract acidity and formation level of intermediate active products are carried out. It was established that the modification of properties of grape raw material depends on type of grapes, requirements of vacuum drying and radiation dose by electrons.

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1. INTRODUCTION

Recently the increasing preference is given to the medicines made of vegetative raw material as contrasted to the synthetic medical products owing to indirection of the latter. Now the perspective development of new biologically active products is carried out on the basis of grape use for deriving polyphenols in the form of flavonoids. The grape is the best source of vitamins, mineral substances and microelements, it normalises activity of human organism, assists as preventive measure of many diseases and has medical properties. Value of grape and products of its processing in human nutrition cannot be overestimated. It is not only the important source of receipt of easily assimilated sugar for organism, organic acids, vitamins, microelements, but it also raises comprehensibility of nutrients, first of all albumen. Perspective development of new biologically active products is carried out on the basis of use of grape pressings for deriving medical products. According to the literature data one of the most perspective directions of use of grape pressings is the pharmaceutical industry. Flavonoids have the greatest popularity and commercial value. They became a part of the medical substances conventional in the world such as "Endotelon", "Piknogenol", "Activna", "Antiox". These specimens are used for treatment and preventive measures for cardiovascular diseases, decrease of level of cholesterol in blood, rejuvenation of organism. The commercial cost of these extracts exceeds in many times the cost of the initial product - grape.

Grape pressings is a perishable product which is saved without processing 2-3 days, further use of grape pressings is inexpedient. During the season of vintage and its processing hundred thousand tons of grape pressings remain. Special machining is necessary for long-term storage of grape and products of its processing with the purpose to avoid its spoilage. There are many ways of storage. They are canning, freezing, drying. The most efficient is drying. Therefore, it is necessary to create high-performance energy-saving dryers which could dry big amount of grape pressings up to moisture of 6…8 % and thus to save useful substances in the dried product. At such moisture content the grape pressing can be saved during long-term period and to be used in national economy as necessary. Grape pressings can be used as raw material for creation of medical specimens and as a high-caloric food additive. We create thermal vacuum dryer which helps to obtain ecology safe dehydrated foodstuff at temperatures 40…60 °C and thus to save useful substances in the dried products [1,2].

The purpose of this paper is research of effect of different temperature regimes of vacuum drying onto the dynamic of the extracted substances, and also onto intensity of free-radical processes in grape husks and pressing, exposed to radiation by different doses of ionised irradiation.

2. RESULTS AND DISCUSSION

Identification of monomer polyphenols in grape extracts of bagasse and husks was carried out for the following kinds of grape: Cabernet and Rkatsitely - the most widespread representatives of red and white kinds of grape among industrial plantings in Ukraine.

The data obtained during this research is presented in Tables 1 and 2 (method of chromatography). The tables show that the grape bagasse contains significant amount of polyphenols of grape, and its content is the most in the husks of grape berry.

Table 1. *Polyphenols of Rkatsitely grape (concentration, mg/dm^3)*

№	Polyphenols name	In the pressing	In the husks
1	Gallic acid	270	448
2	Chlorine acid	20	-
3	Protokatekh acid	2,7	-
4	Lilac acid	70,7	104,9
5	Routin	6,8	28,5
6	Kvertsetin	2,1	23,8
7	Resveratrol	-	1,1
8	Ketekhin	-	739,6
9	Epikatekhingallat	-	78,0

According to the data of Tables 1 and 2 it is obvious that on composition of monomer polyphenols the extracts of bagasse and husks of red grape Cabernet and white grape Rkatsitely differ a little.

Table 2. *Polyphenols of Cabernet Grape*

№	Polyphenols name	In the pressing	In the husks
1	Gallic acid	1180	2094
2	Chlorine acid	111,8	-
3	Protokatekh acid	2,6	-
4	Lilac acid	67,2	-
5	Routin	88,8	61,5
6	Kvertsetin	117,5	35,3
7	Resveratrol	2,6	0,6
8	Ketekhin	121,6	1026,6
9	Epikhtekhin	88	64,2
10	Epikatekhingallat	5,5	6,6

The grape bagasse and husks have been dried in vacuum dryer at different temperatures 40, 50, 60 °C and pressure of 16 mm Hg. It was determined, that the lower is the temperature of drying, the less is concentration of hydrogen ions in the extract. This proves that the process of extraction goes more intensively. The process of extraction is inhibited at higher temperatures of drying.

Dependence of intensity of extraction from Cabernet grape husks is presented on the Fig. 1. It was dried at different temperatures in vacuum dryer down to moisture of 8%.

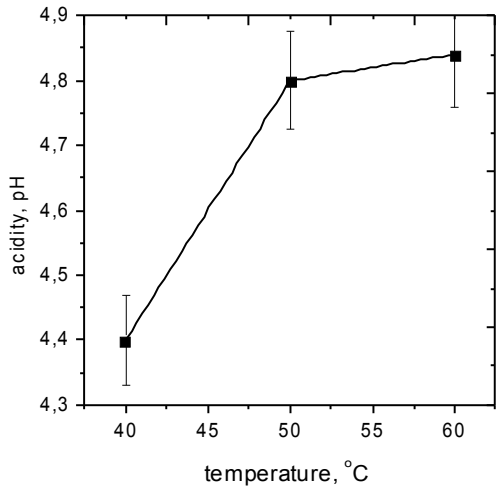

Fig. 1. *Dependence of hydrogen ions concentration versus temperature of vacuum drying of Cabernet grape husks. The time of drying is 60 min*

The results of research confirm that intensity of extraction from the executed material at temperature 40^0C is higher than at higher temperatures. So, for example, at temperatures 50 and 60 °C intensity of extraction is dropped.

To increase the intensity of extraction from grape husks and bagasse the bombarding radiation by electrons with energy 12 MeV using the linear accelerator of electrons was conducted. Radiation doses have made 10, 20 and 40 kGy. Raise of acidity after processing of raw material by irradiation is one of major factors of the affecting mechanism of ionising radiation on the process of extraction [3].

One can see on the Table 3 one of the experiments describing dynamics of extraction of extractives from Cabernet grape husks after vacuum drying at the temperature 50^0C using different radiation doses.

Table 3. *Dynamics of extraction of extractives from Cabernet grape husks after vacuum drying at the temperature 50^0C using different radiation doses*

Radiation dose, kGy	Time of extraction, min				
	60	180	360	540	900
	Extractive substances, pH				
0	4,8	4,8	4,6	4,0	4,0
10	4,6	4,4	4,2	4,0	4,0
20	4,4	4,0	3,8	3,6	3,6
40	4,6	4,4	4,0	4,0	4,0

After radiant processing of grape husks, dried at temperature 50^0C in vacuum dryer, the increase of hydrogen ions concentration relatively to unirradiated samples was registered. It has been established during the experiment, that radiant processing of raw material increases the process of extraction in comparison with unirradiated raw material. The most intensity of extraction was noted at radiation dose 20 kGy.

Complexity of structure of components of vegetative raw material creates numerous interacting with radiation, that probably leads to the formation of various products of radiolysis. At bombarding radiation of these products at the doses more than 60 kGy, the disintegration of these products with formation of organic acids and formaldehydes is possible. The volatile acids are formed at small radiation doses affecting on these products. The mechanism of increased acidity in the irradiated samples can be explained by the intermolecular transfer of energy, obtained through H-links between hydroxyl groups and molecules of hydrocarbons. The formation of acids at radiation bombarding the samples containing hydrocarbons, apparently, is possible to explain also by presence of water, which gets in crystal structure and modifies the network of hydrogen links with hydroxyl groups, disturbing thus transfer of energy between joints. The increase of density of hydrogen ions leads to change of structure of the cell shell, decrease of viscosity of extracts, breaking down of complex joints, and also increase in penetrability of membrane structures of cells, absorptivity, etc.

Change of properties of vegetative raw material under affect of ionising radiation can be stipulated by existence of some processes, as a result of which intermediate active products are formed - free radicals, ions in the excited state**.** Quantometer method [4,5] was used to measure quantity of the formed free-radical

products in bagasse and husks of grape, dried in vacuum dryer depending on the dose of ionising radiation (Fig. 2). It is obvious from Fig. 2, that bombarding radiation expedites process of formation of highly-reaction products in probed samples.

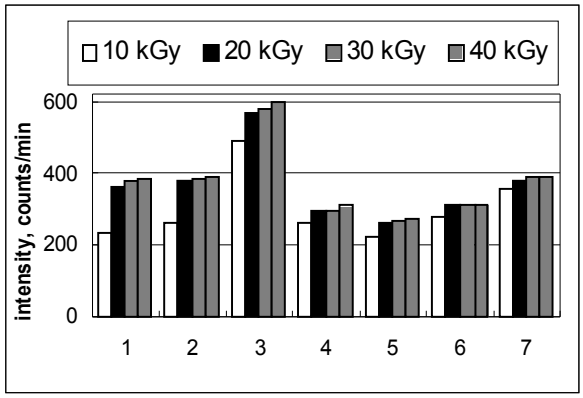

Fig. 2. *Diagrams of intensity of free-radical products in bagasse and husks of different types of grape which has been dried by vacuum drying versus the dose radiation: 1–bagasse of Cabernet grape dried at 60°C; 2–bagasse of Rkatsitely grape dried at 60°C; 3 –bagasse of Cabernet grape dried at 40°C, 4–husks of Cabernet grape dried at 60°C, 5–husks of Rkatsitely grape dried at 60°C, 6–husks of Cabernet grape dried at 50°C, 7–husks of Cabernet grape dried at 40°C*

CONCLUSIONS

The thermal-vacuum dryer for different types of grape processing was used for this paper accomplishment. The results of researches proved, that it is most effective to dry the grape raw material at the temperature not above 40^{O}C. The expediency of application of ionising radiation in the technology of obtaining phyto-chemical products from the dried.

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ИЗУЧЕНИЕ МЕХАНИЗМА РАДИАЦИОННО-ХИМИЧЕСКИХ И ТЕРМИЧЕСКИХ ПРЕВРАЩЕНИЙ В ПРОДУКТАХ ПЕРЕРАБОТКИ ВИНОГРАДА

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Экстракция биологически активных веществ была проведена с помощью комбинации физических факторов: различные режимы температуры (40, 50, 60°С) и давления вакуумной сушки (8, 14, 16 мм Hg), а также различные дозы облучения электронами с энергией 12 МэВ (10, 20, 40 кГр). Проведены исследования динамики определения кислотности экстрактов и уровня образования промежуточно-активных продуктов. Показано, что изменение свойств виноградного сырья зависит от сорта винограда, условий вакуумной сушки и дозы облучения электронами.

ВИВЧЕННЯ МЕХАНІЗМУ РАДІАЦІЙНО-ХІМІЧНИХ І ТЕРМІЧНИХ ПЕРЕТВОРЕНЬ У ПРОДУКТАХ ПЕРЕРОБКИ ВИНОГРАДУ

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Екстракцію біологічно активних речовин було проведено за допомогою комбінації фізичних факторів: різні режими температури (40, 50, 60°С) і тиску вакуумного сушіння (8, 14, 16 мм Hg), а також різні дози опромінення електронами з енергією 12 МеВ (10, 20, 40 кГр). Проведено дослідження динаміки кислотності екстрактів і рівня утворення проміжних активних продуктів. Показано, що зміна властивостей виноградної сировини залежить від сорту винограду, умов вакуумного сушіння і дози опромінення електронами.