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**RESEARCH OF PHYSICAL AND CHEMICAL INDICES
AND RHEOLOGICAL PROPERTIES OF APPLE PUREE
DIFFERENT SORTS AND PROCESSING METHODS**

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Summary. The results of physical and chemical indices research of different apple sorts as well as organoleptic and rheological properties of the apple puree preserved by different methods have been considered. The selection of the best quality sorts and processing methods for the purpose of improvement in the quality of apple puree has been substantiated.

Key words: apples, apple puree quality, physical and chemical indices, processing methods, apparent viscosity.

Problem statement. The environment and foodstuffs contamination by toxic matters is the problem of many regions in Ukraine requiring the expansion in production volume for the products containing pectin as natural detoxifier.

Apples as natural source of pectin matters are widely used in industrial processing. Thus their quality, maturity degree, form, size, organoleptic properties and their chemical composition are taken into account for defining mass part of dry solvents, sugars, acids, pectin matters and such like.

Technologies being nowadays used for fruit puree production dissatisfy the demand on this type of products. The lack of high-quality prepared food forces domestic canning enterprises to use the concentrated fruit purees of imported production [4].

An apple puree enables to form jelly and it can be obtained from the winter sorts of apples having dense pulp, well expressed

taste and aroma, with the content of pectin matters about 1%, organic acids – 0,5% and sugars – 6-10 % [2]. Consequently, processing of nonstandard garden-stuffs of apples is perspective and economically expedient.

Recent researches and publications analysis. Studies [3, 4, 6] demonstrated that thermal treatment promotes depolymerization, violates hydrogen connections in pectin matters facilitating to their subsequent swelling and dissolution. As a result of middle layer integrity loss, the decline of pulp firmness and increase in soluble pectin mass part, there is softening influence of parenchymal tissue of raw material as well as viscosity increase of puree-type fruit mass.

For decreasing viscosity and increasing of puree-type fruit mass fluidity it is suggested to conduct treatment by means of pectolytic enzymic preparations. However, such a treatment facilitates to deep pectin matters destruction as well as loss of homogeneous structure by a product. The results obtained for defining apparent viscosity show that it is possible to characterize fruit puree according to its textural signs and rheological properties as non-newtonian (structured) liquids. Fruit mass rheological properties stipulate not only product quality but also the change of its properties under subsequent storing and using [1, 3, 4, 7].

The purpose of research. To study physical and chemical indices of different sorts of apple-tree garden-stuffs for defining the best suitable for the puree production as well as defining apple puree microwave treatment influence on its organoleptic and rheological properties in order to increase product quality and its ecological safety.

Main part. Researches were conducted at the laboratories of «Technology of processing and storing of agriculture products» and «Technical mechanics» departments, TSATU. The apple-tree garden-stuffs of the zoned and perspective sorts grown in LTD «Black see fruit company» in the village of Kostyantynivka, Melitopol district, Zaporizhzhya region were used.

Physical and chemical indices for defining apples has been conducted in fivefold replication according to standard methods [5]. The results of researches are given in the table 1.

Table 1 – Physical and chemical indices of apples depending on a sort

Sort	Mass part of dry matters, %	Mass part of sugars, %	Titratatic acidity (in recalculation to malic acid), %	Mass part of pectin matters, %
Breburn	12,49±0,05	9,990±0,112	0,502±0,024	1,36±0,18
Jonagold	13,23±0,08	10,585±0,385	0,427±0,012	1,45±0,12
GoldenDelishes	10,66±0,09	8,527±0,344	0,234±0,009	1,28±0,09
Renet of Simirenko	11,51±0,05	9,208±0,255	0,570±0,001	1,42±0,11
Fuji	13,18±0,08	10,541±0,241	0,552±0,024	1,51±0,06

As it is evident from the table, all tested sorts of apples as for the content of sugars and pectin matters are suit to raw material for the apple puree production. As for the content of organic acids, the sorts of Jonagold and Golden Delishes have insufficient amount (less than 0,5 %), consequently the puree from such apples will possess non-harmonious taste and low jelly-forming ability. The technology for puree making included the following operations: inspecting, sorting, washing, blanching, seed vessel removing, wiping out of apples, thermal or microwave treatment, whereupon determined organoleptic properties after the generally accepted methods [5] and rheological descriptions of the obtained purees by the rotary viscometer-stirrer of permanent shear tension of VPN-0,2M after a method [1]. For the quantitative demonstration of puree-type fruit mass system state the apparent viscosity being its ultimate index has been defined, characterizing the balanced state between the processes of renewal and disintegration of structure in the flow set.

Apparent viscosity for apple puree was being defined according to the formula

$$\eta = \kappa \cdot U \cdot T \cdot A, \quad (1)$$

where η –apparent viscosity, Pa·s;

κ – constant for measuring unit, Pa/V; $\kappa=13,6$ Pa/V;

U – tension, V;

T –rotation period, s;

A – coefficient of measuring unit form; $A=1,37 \cdot 10^{-2}$.

The results of researches show (fig. 1) that under shear rate increasing the apparent viscosity of apple puree decreases and after complete structure destruction keeps steady. Apparent viscosity diminishes when deformation rate increases, being presupposed by considerable chaotic layout of parts location in immovable environment – that is, in our case, in apple puree.

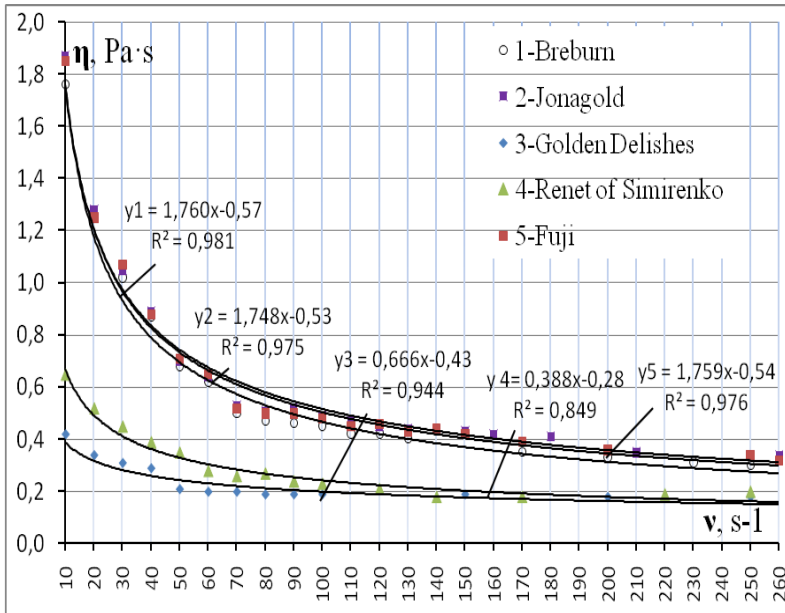


Figure 1 – Apple puree apparent viscosity dependence on shear rate (without treatment).

Non-newtonian character of apple puree flowing is explained by that under shear rate increasing asymmetric molecules in solutions settle in ordered position, being disposed along longer axis. Thus, the direction of long axis coincides with streamline liquid, diminishing the tension and, consequently, providing apparent viscosity diminishing in specimen under testing. Puree specimen of Breburn, Jonagold and Fuji sorts of possess greater apparent viscosity than of other sorts, that may be explained by greater dry matters content (tab. 1).

The research results of different processing methods influence on rheological properties of the made puree (fig. 2) showed dependence of the apparent viscosity of apple puree

(without treatment) and that microwave treatment is in greater extent than traditional thermal (pasteurization) promotes the apparent viscosity, in average per 20-30 % improving physical indices of apple puree quality.

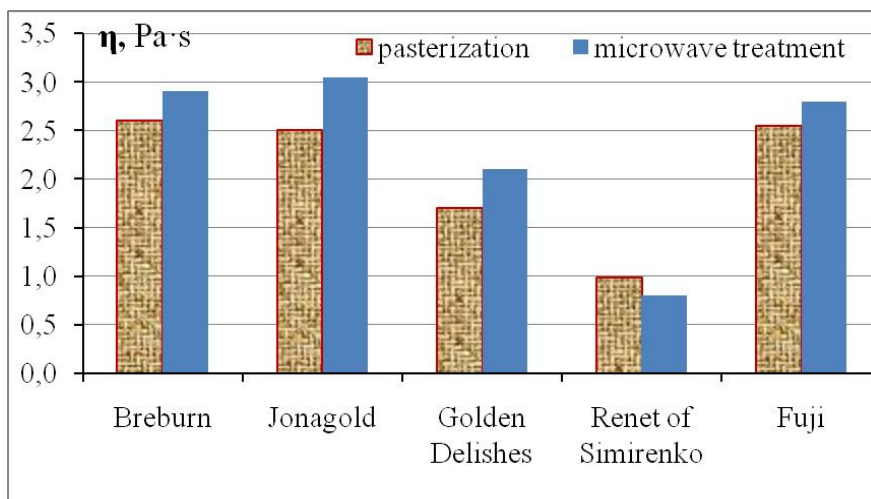


Figure 2 – Apple puree apparent viscosity dependence on the apple sorts and treatment methods.

The above mentioned viscosity changes can be explained by high molecular polysaccharides content in apple pectin. For the puree made from Renet of Simirenko apples microwave treatment turned to be ineffective, as resulting product acquired an unattractive dark color while apparent viscosity had the tendency to diminish.

Conclusions. Processing of nonstandard apple-tree garden-stuffs with high pectin matters content possessing radiation protection characteristics is perspective and economically expedient. The best physical and chemical indices and organoleptic properties (attractive color, high aromatic, harmonious sweetly sour by taste) are characteristic to Renet of Simirenko, Breburn and Fuji apples.

The most apparent viscosity was in purees, made from the sorts of apples with high content of dry matters (12,49-13,23 %) such as Breburn, Jonagold and Fuji.

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ДОСЛІДЖЕННЯ ФІЗИКО-ХІМІЧНИХ ПОКАЗНИКІВ ТА РЕОЛОГІЧНИХ ВЛАСТИВОСТЕЙ ЯБЛУЧНОГО ПЮРЕ РІЗНИХ СОРТІВ ТА МЕТОДІВ ОБ- РОБКИ

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Анотація

В роботі наведено результати досліджень фізико-хімічних показників яблук різних сортів та органолептичні і реологічні властивості виготовленого з них пюре, яке консервоване різними методами. Обґрунтовано вибір кращих сортів та методів обробки з метою підвищення якості яблучного пюре.

Ключові слова: яблука, якість пюре, фізико-хімічні показники, методи обробки, ефективна в'язкість.