ISBN 978-1-64871-458-0
DOI 10.36074/ti:emacaz.ed-1

TECHNOLOGICAL INNOVATION: ENGINEERING, MANUFACTURING, AGRICULTURAL COMPLEX AND ZOOLOGY

Collective Scientific Monograph

EDITION 1

Dallas
2020

Primedia eLaunch
E-book conversion, distribution & marketing

UDC 641.8:641.52 DOI 10.36074/ti:emacaz.ed-1.01

Oksana Dzyundzya[1], Natalya Novikova[2]

THE PROSPECT OF THE TRANSFER OF EGGPLANTS IN FOOD POWDER

ABSTRACT:

The results of research on the development of the latest technological and technical solutions for eggplant processing are presented. The proposed technology solves the problem of rational use of eggplant. Thanks to infrared drying, we get a brand new product that allows you to preserve the nutrients as much as possible. During the heat treatment, the physical and chemical characteristics of the dried material change: density, heat capacity, elasticity, porosity, chemical composition and others. Therefore, the results of studies of the properties of eggplant powders are investigated and presented. Determination of organoleptic, physico-chemical and structural-mechanical parameters, allowing to calculate the required amount of powder, which can be introduced as an additive without affecting the structural-mechanical properties of the finished product. The rational conditions for restoring the rehydration of eggplant powders were established: temperature in the range from 45 ° C to 60 ° C; the duration of swelling 10 - 15 min, the ratio of powder and liquids 1: 3 and 1: 4. The content of toxic elements (Lead, Cadmium, Arsenic, Copper, Zinc) and microbiological parameters (mesophilic aerobic, optional anaerobic, Escherichia coli bacteria, Salmonella bacteria) were investigated. Compliance with the requirements for this type of raw material and the safety of the developed eggplant powders has been established. It is established that the developed food powder has a number of positive qualities, namely: long shelf life, does not require additional storage space, is easily recovered.

Thanks to the technology of infrared drying, which is one of the methods of preserving eggplants, the productivity of the technological process of manufacturing powders is increased. This is explained by the fact that in the same period of time we get twice as much dried product as compared to convective methods. Given the nutritional value of eggplants, powders can be used in various combinations to provide the desired properties of the final product. This will reduce the time for cooking, expand the range of functional products.

So, for studying technological properties of food eggplant powder, there was considered the complex of base functional-technological properties of powder, produced by infrared drying.

For finding optimal conditions of rehydration of eggplant powders, there was studied the influence of such technological factors as: swelling ability; liquid: powder ratio; influence of the solvent temperature on renovation; renovation duration; degree of comminution of powders.

[1] Ph.D. (Technical sciences), Associate Professor at the Department of Food Engineering
Kherson State Agricultural University, UKRAINE

[2] Ph.D. (Agricultural sciences), Associate Professor at the Department of Food Engineering
Kherson State Agricultural University, UKRAINE

Main parameters that influence the renovation ability of dried eggplants are investigated and studied in the article. The results of the studies of technological properties of eggplant powders prove their high rehydration properties. It gives a possibility to use powders at producing different culinary products not only for enriching them with functional ingredients, but also for giving them new technological properties.

Based on the obtained results, there was elaborated and presented the new technological scheme of using renewed powders in food compositions.

INTRODUCTION.

Nutrition is the main factor that provides human body with energy, basic structural elements, and affects functional activity. The relevant problem at present is the provision of high-quality food products with high nutritional value to people. Given the current environmental conditions, the diet should contain biologically active substances (food fibers, pectin, antioxidants, vitamins). Therefore, there is an increasing need for food products enriched with natural ingredients that can correct the deficit of micronutrients, increase the body's resistance to adverse environmental conditions.

The main source of nutrition for the body is vitamins, fruit, and berries. The search for plant raw materials with high technological properties for its use in the production of food products with the prospect of expanding the range, improvement of organoleptic, structural-mechanical, functional-technological indicators and microbiological quality indices is a relevant task.

Eggplants are rather valuable raw material, but a season one [1–3]. One of ways of conservation of vegetable raw materials is drying in powders [4, 5]. The drying process allows to avoid a season character of eggplants consumption, to simplify operations for their culinary processing, to shorten a duration of the technological process of preparing dishes and to widen their assortment, to decrease areas of warehouses and production rooms, to create correspondent sanitary-hygienic conditions. Due to infrared drying, the time of thermal processing of the product shortens and maximal conservation of the nutrient composition is attained. Taking it into account, eggplant powder is a rather promising raw material for being used at enterprises of restaurant economy and food industry.

Eggplant powder is a new raw material, so it is necessary to establish main technological properties for further modeling new culinary products.

Eggplant powder corresponds to requirements, set to this type of raw materials by the content of toxic elements and by microbiological parameters [4, 6].

It must be noted, that the developed powder doesn't need additional conditions of storage, which term is 12 months.

At developing and manufacturing restaurant economy products, it is necessary to know main technological properties of raw materials [7, 8]. So it is very important to study main characteristics of powders. One of criteria of estimating their quality is the rehydration ability. The renovation characteristic of a material depends on many factors, first of all, chemical composition of a raw material, its structure, physical-chemical properties and degree of changes, undergone by a product at drying, and influences the ready product's quality. The incorrect renovation can result in losses of valuable food materials, contained in powder as dry substances. The powder quality depends on an initial raw material, regimes of technological processing, conditions of storage and renovation.

The renovation ability of a material is characterized by a value of the swelling coefficient C_s that indicates the relative decrease of a product mass after swelling and determines the ability to renew initial properties of a material at dehydration [7].

For determining optimal rehydration conditions for eggplant powders, there was studied the influence of the following technological factors:

1) Liquid:powder ratio;
2) Solvent temperature;
3) Renovation duration;
4) Powders comminution degree.

So, the aim of this work is to study the technology of production of food powders and to generalize technological properties of eggplant powder, produced by infrared drying. The obtained experimental material allows to calculate the necessary amount of powder as a food supplement at creating recipes and fast food products and to determine time for preparing dishes.

TECHNOLOGY OF PRODUCTION OF EGGPLANT POWDERS.

Based on food and taste properties, eggplants are a quite valuable raw material. The benefits of eggplants are: the low calorie content; diuretic properties; the capability to normalize work of the heart; the presence of substances purifying the blood vessels from cholesterol; the content of compounds that improve the condition of the joints. According to research results, the eggplant fruits contain: proteins, carbohydrates and insignificant amounts of fats, vitamins (nicotinic acid (B5), thiamine (B1), riboflavin (B2), carotenoids). Carbohydrates are represented by monosomes (glucose, fructose), oligosaccharides (sucrose) and polysaccharides (starch, pectin, fiber). In addition, the fruits of eggplant are rich in mineral salts of phosphorus, calcium, potassium, manganese, magnesium, iron, aluminum. Of particularly large percent is the proportion of potassium salts. The content of ascorbic acid varies from 0.89 to 19.0 mg per 100 g of raw weight, depending on the variety and the region of cultivation [15–20].

The chemical composition of the eggplants grown in the south of Ukraine, namely, in the Kherson oblast (Bilozersky, Tsyurupinsky, Berislavsky regions) was investigated for determining the prospect of the raw material and the dependence of its value on soil (Table 1). This territory is characterized by temperate continental climate and is a leader in growing various crops, especially melons (watermelons, melons) and pastels (tomatoes, eggplants, vegetable pepper).

Despite the different chemical composition of soil, the indicators of the examined samples were almost the same, which is predetermined by the use of various fertilizers that are introduced in order to receive large harvests. Surveys of trade representatives and suppliers of agricultural products revealed that the share of products from Tsyurupinsky region is the largest. Therefore, in the further research, we selected samples from this area.

Table 1

Chemical composition of fresh eggplant ("Diamond" variety, crop 2017)

Indicator	Bilozerskiy region	Tsyurupinskiy region	Berislavskiy region
Water, g	91	91	91
Protein, g	1.2	1.2	1.2
Fat, g	0.1	0.1	0.1
Carbohydrates, incl:	4.5	4.8	5.1
– sucrose, g	0.4	0.4	0.4
– glucose, g	2.4	2.9	3
– fructose, g	0.8	0.7	0.8
– starch, g	0.9	0.8	0.9
Food fibers, g	2.5	2.4	2.5
Vitamins, mg/100 g			
Nicotinic acid	0.6	0.6	0.7
Beta-carotene	0.01	0.01	0.01
Acetylsalicylic acid	5	4.5	5.5
Tocopherol	0.1	0.1	0.1
Thiamine	0.04	0.04	0.04

Table 1 (continued)

Indicator	Bilozerskiy region	Tsyurupinskiy region	Berislavskiy region
Riboflavin	0.05	0.05	0.05
Niacin	0.8	0.8	0.8
Macroelements, mg/100 g			
Potassium	238	235	245
Calcium	15	15	16
Magnesium	9	9	10
Sodium	7	6	6
Phosphorus	34	35	35
Chlorine	47	46	46
Sulphur	15	14	15
Microelements, mg/100 g			
Iron	0.4	0.4	0.4
Zinc	0.29	0.29	0.29
Copper	0.14	0.14	0.14
Manganese	0.21	0.21	0.21

[авторська розробка]

At first glance, eggplant is a product with a low content of essential substances, however, the in-depth studies indicate its value. For example, eggplant contains three groups of carbohydrates (g/100 g): monosaccharides (glucose – 3, fructose – 0.8), oligosaccharides (disaccharides: sucrose – 0.4), homopolysaccharides (starch – 0.9, fiber – 0.13, pectin substances – 0.14), heteropolysaccharides – mucopolysaccharides, whose basis is amino sugar and galacturonic acid. It is important to take into consideration the impact of carbohydrates on the human body; to this end, we determine the glycemic index (GI), which is the conditional value of the rate of cleavage of any carbohydrate-containing product in the human body compared with the rate of glucose splitting. This is a measure of the effect of food on the level of sugar in the blood, namely, the speed at which glucose penetrates the blood. The glycemic index reflects the ratio of glucose concentration in blood after 3...4 hours after consuming 100 g of the studied food product and the level of this indicator after consuming 100 g of white bread. This indicator is affected by: the high content of sweet carbohydrates in a product, the duration of heat treatment, and so on. The lower the glycemic index, the slower the digestion of carbohydrates. The glycemic index of eggplants is 20, hence it is a product with its low content [21]. It is known that products with a low GI are more useful to the body. Products with GI lower than 35 contribute to the effective reduction of body weight. Thus, eggplants can be recommended for eating during the day.

Earlier research has established that processing and consumption utilized whole fruits of technical maturity without defects. That is why a significant proportion of defective raw materials is not sold and is left rotting in fields and landfills. As a result, there is a need to search for potential ways to process eggplants, even in the presence of defects.

The development of new resource-saving technologies resolves the problems related to the rational use of raw materials. That has not only the scientific but also a social aspect, as it forms the scientific basis for rational nutrition and thus improves the quality of life.

Drying is one of the canning techniques, so creating new food powders is a relevant task. There are many types of drying of vegetable raw materials: sublimation with the use of cryo-destruction, convective, conductive, high-frequency, dielectric, infra-red, etc. An analysis of the scientific literature has revealed various techniques for eggplant drying, developed for snacks and investigated in [9, 22], but no technology for obtaining the powders has been identified. In this context, we compared the basic technological operations (Table 2).

Table 2

Basic technological operations in eggplant drying

No	Basic operations		
	Classical technology [9]	Prototype technology [22]	Developed technology
1	Raw material preparation, eggplant slicing into strips with a thickness of 2–3 mm	Raw material preparation, slicing eggplant in longitudinal strips of 6–8 cm in length, with a thickness of 2–3 mm	Raw material preparation, slicing eggplants into strips with a thickness of 3–5 mm
2	Pickling and aging for 10–20 min	Preparation of a 1 % salt solution with ascorbic acid	Preparation of a 1 % salt solution with citrine acid and bringing the solution to boiling
3	Washing	Aging the sliced eggplant for 20 minutes	Aging the sliced eggplant in a hot solution for 5–10 min
4	Drying at convective driers at a temperature of 40–70 °C to a 14 % humidity	Moisture removal and washing	Moisture removal

Table 2 (continued)

No	Basic operations		
	Classical technology [9]	Prototype technology [22]	Developed technology
5	–	Aging in blending juices for 30 min	Drying at infrared drier at a temperature of 50–60 °C, to a 10 % humidity
6	–	Drying at a convective drier at a temperature of 70 °C during 10 min and then at a temperature of 55 °C during 5 hours	Grinding the dried eggplant into powders
7	–	–	Sieving

[авторська розробка]

The proposed technology makes it possible to obtain a dried semi-finished product from eggplant, which is not inferior in its organoleptic indicators to prototypes. This, in turn, makes it possible to obtain a high-quality powder (Fig. 1).

a *b*

Fig. 1. **Products of eggplant processing:**
a – dried eggplant, b – eggplant powder

RESEARCH OF QUALITY INDICATORS OF EGGPLANT POWDERS.

Drying of eggplants at infrared dryers makes it possible to maximally retain their nutrient substances.

The mineral composition of eggplant powders on average increases by

2.5–3.0 times, dominated by, mg/100g: calcium (48.5±2.0), potassium (740.4±2.0), iron (1.7±0.5), phosphorus (98.80±1.5), magnesium (26.18±2.0). All these elements are an integral part of the bone tissue, they have radiation protective and anti-anemic properties, and, therefore, are vital to humans.

The amount of vitamins of group B (B1 and B_2), PP increases by more than 10 times and is, mg/100 g: thiamine B_1 – 0.40±0.01; riboflavin B_2 – 0.5±0.06; nicotinic acid PP – 5.22±0.10.

Eggplant powders are an additional source of vitamins, which is especially important for regulating the metabolism and improving the resistance of the body to various negative environmental factors.

Vitamins are part of the enzymes that provide important metabolic processes in the body. Water-soluble vitamins of eggplant powders (PP, B_1, B_2) promote cellular metabolism.

As a summary, it can be argued that the elevated level of mineral elements, B group vitamins, niacin, in eggplant powders will contribute to the overall strengthening of the body and will enhance the protective effect of the immune system. That in turn improves resistance of the organism to adverse environmental factors.

It is evident that the addition of eggplant powders as a food additive will result in the formation of the corresponding consistency, color, flavor, and taste in the finished products. Therefore, special attention should be paid to studying the quality indicators and basic technological properties of powders.

Basic organoleptic indicators of the functional eggplant powders are given in Table 3.

Table 3

Organoleptic parameters of functional powders

Indicator	Powder characteristics
Physical appearance	Powder-like mixture, homogeneous, without foreign impurities, the presence of easily soluble lumps is allowed
Consistency	Homogeneous
Dispersity	< 0.5 mm
Color	From light brown to brown
Aroma	Characteristic of this dry raw material, without foreign odors
Taste	Taste of dry raw material without foreign impurities

[авторська розробка]

In terms of the content of toxic elements, the eggplant powder must meet the requirements specified in Table 4.

Table 4

Toxic elements content in eggplant powders

Indicator name	Acceptable level, mg/kg, not exceeding	Eggplant powders	Control method
Lead	0.5	0.1±0.02	GOST 26932
Cadmium	0.03	Not found	GOST 26933
Arsenic	0.2	Not found	GOST 26930
Copper	5.0	0.16	GOST 26931
Zinc	10.0	2.04	GOST 26934

[авторська розробка]

In terms of microbiological indicators, eggplant powder must meet the requirements specified in Table 5.

Table 5

Microbiological indicators of eggplant powders

Indicator	Standard	Eggplant powders	Control method
Number of mesophilic aerobic and facultative-anaerobic microorganisms, CFU/g, not exceeding	5.0×10^4	$<1.0 \cdot 10^1$	GOST 10444-15
Escherichia sticks (coliforms), per 0.1 g of product	Not permitted	Not found	GOST 26972
Pathogenic microorganisms, including bacteria of the genus Salmonella, per 25 g of product	Not permitted	Not found	GOST 9958

[авторська розробка]

It is known that powders can be introduced to a formulation both in the dry and in the restored form [4]. However, to obtain products with high quality indicators, it is better to use the hydrated powder.

One of criteria of estimating the quality of dry products is the ability to swelling that depends on the chemical composition and water-retaining ability of powder. It was established, that dispersity influences the value of the water-retaining ability. At dispersity > 0,315 mm =80%, > 0,25mm = 60 %, 0,16mm = 56%. Despite the obtained data, it is most optimal to study powders with dispersity 0,25 mm.

Optimal conditions of powder renovation were chosen depending on such parameters as rehydration duration, hydromodule (1:2, 1:3, 1:4, 1:5, 1:6), solvent temperature (20, 40, 60, 80, 100 ºC) (fig. 2).

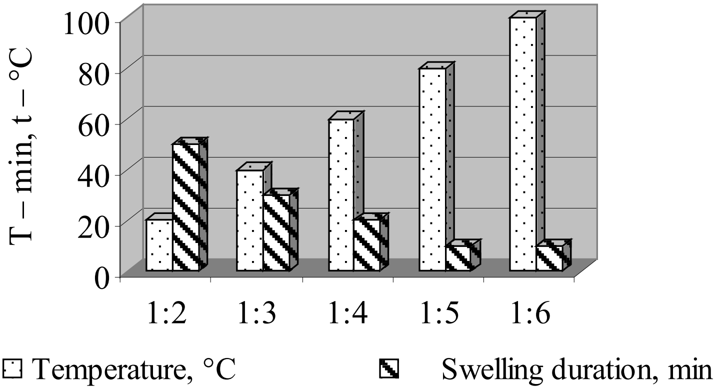

Fig. 2. **Dependence of temperature and dissolution duration of eggplant powders**

The important role at powders renovation is played by the temperature of water, taken for hydration. It was established that the powder has the high swelling and renovation ability, and the speed depends on the water temperature and dispersity.

It was experimentally established, that powder with sizes of particles less 0,25 mm has a puree-like mass, like in the control. Powders of different fractions were left for 24 hours for watering, as a result the amount of water, taken by dry eggplants with different comminution degrees, was practically equal.

It was established, that at the beginning of the process the water-absorbing ability is higher than in a certain time interval after the beginning. In first $3{\cdot}10^2 \ldots 6{\cdot}10^2$ s a certain amount of water is absorbed by powders with the further decrease of the absorption speed. Losses of soluble substances reach maximum in $6{,}0{\cdot}10^2$-$9{,}0{\cdot}10^2$ s the further increase of the rehydration duration (to $1{,}8{\cdot}10^3$s) is accompanied by the increase of the water-absorbing ability of powders and it becomes the same as at the beginning in first $3{,}0{\cdot}10^2$-$6{,}0{\cdot}10^2$

s. At the same time diffusion processes finish, and there is no increment of the amount of extracted substances. There is observed its decrease at the expanse of absorption by swelled powder particles.

The essential increase of the rehydration ability in powders is observed at temperatures less 60 °C, at the further water temperature increase it remains practically the same (table 6).

Table 6

Influence of solvent temperature on renovation of eggplant powders

Hydromodule / temperature , °C	Swelling coefficient, %	Dry soluble substances, %	Renovation ability, %
1:2			
20	2,7±0,13	7,2±0,36	36,7±1,84
40	3,5 ±0,17	7,9±0,40	63,2±3,16
60	3,8 ±0,18	8,3±0,42	86,0±4,30
80	3,8 ±0,18	8,5±0,43	86,2±4,31
100	3,8±0,18	8,5±0,43	86,3±4,32
1:3			
20	3,4±0,17	7,8±0,39	42,0±2,10
40	4,0±0,20	8,5±0,43	78,4±3,93
60	4,5±0,23	9,5±0,48	94,0±4,70
80	4,7±0,24	9,6±0,48	94,5±4,73
100	4,8±0,24	9,6±0,48	94,5±4,73
1:4			
20	3,8 ±0,18	7,6±0,38	39,8±1,99
40	4,0±0,20	8,6±0,43	64,9±3,25
60	4,7 ±0,23	9,6±0,48	92,9±4,65
80	4,7 ±0,23	9,5±0,48	93,1±4,65
100	4,7±0,23	9,5±0,48	92,9±4,65
1:5			
20	3,8±0,18	7,4±0,37	38,0±1,90
40	4,1±0,20	8,2±0,42	62,5±3,13
60	4,7 ±0,23	8,6±0,43	83,0±4,15
80	4,7 ±0,23	8,7±0,43	83,1±4,16
100	4,7 ±0,23	8,6±0,43	83,1±4,16
1:6			
20	3,4±0,17	7,2±0,36	36,4±1,82
40	3,8±0,18	8,1±0,41	65,6±3,23
60	4,4±0,22	8,6±0,43	82,3±4,12
80	4,3±0,22	8,5±0,43	82,4±4,12
100	4,2±0,21	8,5±0,43	82,3±4,12

Note. * Difference is reliable, p<0,05.
[авторська розробка]

The analysis of the obtained data demonstrated that the swelling coefficient of eggplant powders at temperature 20°C in the experiments with equal renovation durations has a tendency to the growth with increasing the water-powder ratio.

It was established (table 1), that at the powder-water ratio as 1:2 the swelling coefficient was 2,7 %, and at 1: 4 and 1: 5 - 3,8 %.

At the temperature increase to 40°C and 60°C there is traced the same regularity. Namely: at 1:2 – 3,5% and 3,8% and at 1:5 – 4,1% and 4,7%.

At the rehydration duration increase from $3{,}0\cdot10^2$s to $1{,}8\cdot10^3$s and water temperature increase to 60°C the water-retaining ability of eggplant powder puree increases, that is testified by the ability of restored powder to retain moisture after centrifuging. At the renovation water temperature increase to 80 °C, the powder ability to retain moisture decreases.

Table 7

Changes of rheological characteristics of renewed eggplant powders depending on rehydration duration

Thermal processing duration, 10^2s	Viscosity, Pa·s	Fluidity 10^2 $Pa\cdot s^{-1}$	Dynamic limit of fluidity Pa·s
$3{,}0\cdot10^2$	1,80±0,7	7,60±0,7	5,10±0,8
$6{,}0\cdot10^2$	2,48±0,9	8,0±0,6	4,7±0,8
$12{,}0\cdot10^2$	2,48±0,9	8,2±0,4	4,7±0,7
$18{,}0\cdot10^2$	3,1±0,7	8,3±0,4	4,3±0,7

Note. * Difference is reliable, $p<0{,}05$.
[авторська розробка]

At powders renovation there takes place extraction of soluble substances, mainly due to diffusion. In all cases losses of soluble substances reach maximum at 6,0…$9{,}0\cdot10^2$ s. The further rehydration duration increase to $1{,}8\cdot10^3$s and more results in the water-absorbing ability decrease.

The most important parameter is a rehydration duration. As far as viscosity gains its maximal value at 60 °C, for studying the influence of the swelling duration on powders renovation, just these samples with hydromodules 1:3, 1:4, 1:5, 1:6 were taken. Renovation was realized during 3,0–$18{,}0\cdot10^2$ s. It was established, that the viscosity increase is observed in first 6,0…$9{,}0\cdot10^2$s. The swelling time increase to $1{,}8\cdot10^3$ s doesn't essentially influence the viscosity of obtained puree and reaches its maximal value at the temperature from 45°C to 60 °C and at hydromodule 1:3. It was established, that the viscosity increase takes place during $9{,}0\cdot10^2$s, the essential amount of pectins results in gelatinization of obtained puree with hydromodules 1:4, 1:3. As a result of renovation there forms gel that gives the correspondent consistence to puree of powders. The rational conditions for rehydration is the liquid temperature less 60 °C, swelling duration 6,0…9,0·10² s, with powder-liquid ratio 1:3, 1:4.

For the quality estimation of restored powder, there were determined rheological properties in the prepared samples (viscosity, fluidity, dynamic limit of fluidity, taking into account the fact that puree is a disperse system (table 8).

Table 8

Rheological parameters of restored eggplants powders

Parameters	puree of eggplants	puree of eggplant powder (hydromodule)					
		1:1	1:2	1:3	1:4	1:5	1:6
Dynamic viscosity, Pa·s	13,60	18,40	15,60	12,70	11,98	8,62	5,25
Dynamic limit of fluidity, 10²Pa	4,66	7,20	5,25	4,70	4,44	1,92	1,80
Fluidity, 10²Pa·s⁻¹	7,91	4,60	6,49	8,20	9,36	12,81	16,73
Plastic viscosity, Pa·s	3,20	0,78	1,44	2,48	3,30	4,83	6,06
Plasticity coefficient	0,97	0,60	0,73	0,89	0,92	1,27	2,03

[авторська розробка]

At powder-water ratio 1:1 the dynamic viscosity of prepared powder is rather high – 18,4 Pa·s, that is by 26 % more than one of the control sample. The hydromodule increase to 1:3 brings the dynamic viscosity of restored powders close to indices of fresh puree. So, the dynamic viscosity of obtained renewed powder is by 6% less than the control at the hydromodule 1: 3.

At the further hydromodule increase to 1:5 and 1:6 the dynamic viscosity index decreases by 36 % and 61% respectively. The analogous changes take place also with other rheological indices of restored powders.

The obtained data testify to high rehydration properties of developed powder that is an important factor at creating culinary products.

Based on the obtained data, there was elaborated the general scheme of eggplant powders renovation (fig 3).

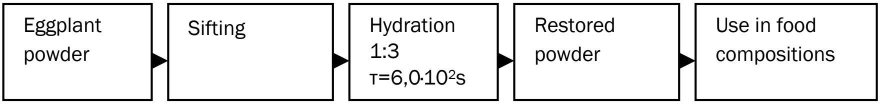

Fig. 3. **General technological scheme of using restored eggplant powders in food compositions**

The advantage of developed powders is the high renovation level, comfort use, long storage life without special conditions. Their use gives a possibility to create biologically active complexes for providing physiologically full value dishes that allow to influence organoleptic parameters, structural-mechanical properties of ready products essentially.

The perspective of further studies is to define ways of further use of eggplant powders and creation of culinary products, based on them. Determination and study of their influence on structural-mechanical properties and chemical composition of developed products defines a way of further studies.

CONCLUSIONS.

Eggplant food powder is a fairly expensive raw material and has several benefits.

1. It was established that eggplants are a low-calorie raw material containing: proteins – 1.2 g, fats – 0.1 g, carbohydrates – 4.8 g. In addition, the fruits of eggplant contain the necessary mineral salts of: phosphorus (35 mg/100 g), calcium (15 mg/100 g), potassium (235 mg/100 g), manganese (0.21 mg/100 g), magnesium (9 mg/100 g), iron (0.4 mg/100 g). The glycemic index of eggplants is 20, which indicates a product with its low content.

2. The technology of eggplant powder production has been developed. The difference from the prototype is that during preparation of eggplant, its processing and aging last for 10 minutes in a 1 % salt hot solution, with citric acid. The use of infrared drying reduces the time of the product dehydration, compared to convective, by 50 %. This technique made it possible, by aging the eggplants in boiling water for 10 minutes, to deactivate most of the enzymes, retain the light color, reduce the drying time by 50 %, compared to the convective drying, and obtain a high-quality eggplant powder at a temperature of 50–60 ºC.

3. The drying of eggplants at infrared dryers makes it possible to maximally retain nutrients. The mineral composition of eggplant powders is, mg/100 g: calcium (48.5±2.0), potassium (740.4±2.0), iron (1.7±0.5), phosphorus

(98.80±1.5), magnesium (26.18±2.0). All these elements are an integral part of the bone tissue, they have radiation-protective and anti-anemic properties, and, therefore, they are vital to humans. The amount of vitamins is, mg/100 g: thiamine B_1 – 0.40±0.01; riboflavin B_2 – 0.5±0.06; nicotinic acid PP – 5.22± 0.10.

4. According to the organoleptic indicators, eggplant powders are a homogeneous powder-like mixture, of light brown to brown color, with a dispersity of up to 0.5 mm. In terms of the content of toxic elements and microbiological indicators, the eggplant powder meets the requirements for this type of a raw material. It was established that the optimal conditions for restoring the eggplant powders are a temperature in the range from 45 °C to 60 °C with a swelling time of about 10–15 minutes, at a ratio of the powder to liquids of 1:3 and 1:4.

5. The optimal conditions for powders rehydration as liquid temperature less 60°C, swelling duration 6,0...9,0·10^2 s, with liquid-powder ratio 1:3, 1:4 were determined.

6. Based on the obtained results, the general technological scheme of using eggplant restored powders in food compositions was elaborated.

7. The research results demonstrated the high degree of powders renovation. It gives a possibility to use powders at producing different culinary products as a functional supplement not only for enriching them with functional ingredients, but also for giving them new technological properties. They are able to improve structural-mechanical properties and outlook of ready products.

The prospect for the further research is to determine the ways for the further use of eggplant powders and to create new meals with the predefined properties to normalize the activities of the human body. Scientific studies as to possibilities of using eggplant powders in technologies of culinary dishes and the influence of the offered supplements on the food and biological value of products on their base are expedient.

REFERENCES:

[1] Snezhkin Yu.F., & Petrova Zh. O. (2010) Kharchovi poroshky z roslynnoyi syrovyny. Klasyfikatsiya, metody otrymannya, analiz rynku [Food powders of vegetable raw materials classification, methods of obtaining, market analysis] *Biotechno-logia Acta*. 3, 5, 43-49. [in Ukrainian].
[2] Pohozhykh M. I., Yevlash V. V., Nyemirich O. V., Tarasenko T. A., Havrysh A. V., Novosad O. O., & Kardavar K. M. (2013) *Sposib vyrobnytstva sushenoyi kapusty* [Method of production of dried c abbage] Ukraine Pat. No. 107146[in Ukrainian].
[3] Pyo, J. G. (2014). Pat. No. 1020140040963 Korean: *Preparing method of apple chips.*
[4] Snyezhkin YU. F., & Petrova ZH. O. (2009) *Novi kharchovi produkty v ekolohiyi kharchuvannya:*

zb. materialiv [New food products in the ecology of nutrition].Lviv, 75, 76. [in Ukrainian].
[5] Sarafanova L. A. (2009) *Sovremennyye pishchevyye ingrediyenty. Osobennosti primeneniya* [Modern food ingredients. Features of the application]. A,SPb.: Professiya, 208 [in Russia]
[6] Snezhkin, Y., & Shapar, R. (2009), An analysis of factors that increase efficiency of the process of drying of thermolabile materials [Analiz faktorov povyisheniya effektivnosti protsessa sushki termolabilnyih materialov], *Industrial Heat Engineering*, 31(7), 110–112. [in Ukrainian].
[7] Poperechnyi A. M., & Korniichuk, A. V. (2010) Doslidzhennia protsesu sushinnia kartoplianoho piure Sheina. *Tematychnyi zbirnyk naukovykh prats "Obladnannia ta tekhnolohii kharchovykh vyrobnytstv"*, (25). Donetsk: DonNUET. [in Ukrainian].
[8] Sheyina A. V., & Meschanin B. A. (2017) Eksperymentalni doslidzhennia sushinnia harbuzovoho piure [Experimental additions of pumpkin powder]. B*ook of abstract the International scientific and technical conference of young researchers and students "Current issues in modern technologies"* (Tern., 16-17 November 2017), (3), 170-171 [in Ukrainian].
[9] Aydogdu, A., Sumnu, G., & Sahin, S. (2015). Effects of Microwave-Infrared Combination Drying on Quality of Eggplants. *Food and Bioprocess Technology*, 8(6), 1198–1210. doi:10.1007/s11947-015-1484-1 [in Turkey].
[10]DSTU 8446:2015. *Produkty kharchovi. Metody vyznachennia kilkosti mezofilnykh aerobnykh ta fakultatyvno-anaerobnykh mikroorhanizmiv* (2015). Kyiv, 16. [in Ukrainian].
[11]DSTU 8447:2015. *Produkty kharchovi. Metod vyznachennya drizhdzhiv i plisenevykh hrybiv* (2015). Kyiv, 15. [in Ukrainian].
[12]*Produkty pyshchevye. Metody vyyavlenyya y opredelenyya kolychestva bakteriy hruppy kyshechnykh palochek (kolyformnykh bakteryy)* [Food products. Methods of detection and determination of the number of bacteria of the coli bacteria group] (2000).GOST 30518-97 *from 1t July*. Kyiv: Gosstandart of Ukraine [in Ukrainian].
[13]*Produkty pyshchevye. Metod vyyavlenyya bakteryy roda Salmonella* [Food products. Method of detection of bacteria of the genus S'lmonelea] (2000). GOST 30519-97 *from 1t July*. Kyiv: Gosstandart of Ukraine [in Ukrainian].
[14]B. Y. Antonov, V. Y. Fedotova, & N. A. Sukhaya.(1989) *Laboratornye yssledovanyya v veterynaryy: khymyko-toksykolohycheskye metody: sprav* [Laboratory research in veterinary medicine: chemical-toxicological methods: cases]. Moscow: Agropromizdat [in Rusian].
[15]Syrokhman, I. V., & Zavhorodnia, V. M. (2009). *Tovaroznavstvo kharchovykh produktiv funktsionalnoho pryznachennia* [Commodity study of functional food products] Kyiv: Vydavnytstvo Tsentr uchbovoi literatury, 544. [in Ukrainian].
[16]Pylypchuk H.(2010) Baklazhany – zasluzheno populyarni [Bakljany – deservedly popular] *Medychna hazeta Ukrayiny «Vashe zdorovya»*, (13), 2-3 [in Ukrainian].
[17]Singh AP, Luthria D, Wilson T, Vorsa N, Singh V, Banuelos GS, & Pascal S. (2009) Polyphenols content and antioxidant capacity of eggplant pulp. *Food Chem*, (114), 955-961.
[18]Magioli C, & Mansur E. (2005) Eggplant (Solanum melongena L.): Tissue culture, genetic transformation and use as an alternative model plant. *Acta Botanica Brasilica*, 19(1), 139-148.
[19]Boubekri C, Rebius A, & Lanez T. (2012) Study of the antioxidant capacity of different parts of two South Algerian eggplant cultivars. *Journal of Fundamental and Applied Sciences*, (4), 16-25.
[20]Jung EJ, Bae MS, Jo EK, YH Jo, & Lee SC.2011 Antioxidant activity of different parts of the eggplant. *J Med Plant Res,* 5(18), 4610-4615
[21]*Hlikemichnyi indeks produktiv - tablytsia* [The glycemic index of products in a table]. Retrieved from http://medfond.com/static/glikemichnii-indeks-produktiv-tablicya.html [in Ukrainian].
[22]Dyakova, Yu. & Orlova, N. (2014) C-vitaminnist baklazhanovykh snekiv [C-Vitaminity of Eggplant Snakes]. *Tovary i rynky – Goods and Markets*, (1), 75-83. [in Ukrainian].
[23]Zozulevych B.V.(1970) Otsenka vostanavlyvaemosty sushenykh materyalov [Assessment of the durability of dried materials]. *Konservnaya y ovoshchesushylnaya promyshlennost. – Canning and vegetable industry*, (2), 29. [in Ukrainian].
[24]Donchenko L., Karpovych N., & Kostenko T. (1992). *Vlastyvosti pektynovykh rechovyn* [Properties of pectin substances]. Kiev.: Znannya [in Ukrainian].