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# Technological properties of wheat flour with additives

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**Abstract.** The research was carried out on the possibility of using potherbs in bakery industry. Powder of plants were used to replace 0.5%, 2%, 5%, 10% and 15% of wheat flour: *Chenopōdium quīnoa* L.; *Cyperus esculentus* L.; *Physalis tomentous* L.; *Cosmos sulphureus Cav.*; *Pycnanthemum virginianum* L.; *Pycnanthemum trifolium* L.; *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze*; *Agastache urticifolia* (Benth.) *Kuntze,* cv. Weide Kerze; *Mentha spicata* L. 'Moroccan'; *Achillea setacea Waldst. Et Kit.*; *Isodon* japonicus var. Glaucocalyx (Maxim*.) H. W. Li*; *Satureja montana* L.; *Teucrium scorodonia* L.; *Ruta montana* L.; *Népeta argolica Bory et Chaub.*; *Népeta grandiflora* L.; *Népeta mussinii Spreng. Ex Henckel.,* cv. Posviata Meisu; *Népeta nepetelia* L. In order to develop an effective technology for its use, creating new types of products with properties that meet current needs of consumers in Ukraine and the world, it is necessary to clarify the relation of potherbs with other components.
Baking properties determine the behavior of flour in technological process, namely, they form the quality of bread and depend on the state of carbohydrate-amylase, protein-proteinase, lipid-lipolytic complexes, as well as the content of compounds that cause darkening of flour during the process of bread making.
Use of herbs in bakery is promising. The data obtained allows manufacturers to recommend the use of herbs during the production of bread.

**Key words:** bread, wheat flour mixture, herbal supplements, gluten, sedimentation, quality.

## INTRODUCTION

### Setting of the problem

Having analyzed modern directions for improving production technologies and improving the quality of bakery products, as well as taking into account the state of public health, today the issue of introducing new types of functional bakery products is topical. There are no enough data as to using volatile-oil-bearing, technical, spicy-gustatory and vegetable plants at baking bread; it is urgent to deepen and widen studies for scientifically grounding ways and methods of their rational use, study of potential possibilities of spicy-gustatory plants as a raw material, widening of bakery

assortment. Help on provision (planting, collection, drying) of little-spread plants for realizing the studies was given by the research associates of the National botanical garden, named after M.M. Gryshko, NAS of Ukraine: S.M. Kovtun-Vodyanitska, D.B. Rahkmetov, O.P. Bondarchuk, O.L. Andruschenko and others.

**Analysis of recent studies and publications**

Bread is one of the most consumed staple foods in the world. It is a good source of nutrients, such as carbohydrates, protein, and fat and micronutrients (minerals and vitamins) which are essential for human health (Omorodion & Oviwighoyovwe, 2022).

Today, providing people with traditional types and varieties of wheat bread remains very important, with the growing demand for bakery products of therapeutic and prophylactic and functional purposes (Chan, 2006; Indani et al., 2010; Pejcz et al., 2014).

Inclusion of herbs in the formulation will ensure the improvement of consumer properties of food, which predictably improves their chemical composition, organoleptic parameters, energy value and assimilation of nutrients (Rosell, 2003; Dhingra & Jood, 2004; Shfali & Sudesh, 2004; Conforti & Davis, 2006).

Extension of the range of bread with high content of biologically active substances can be accomplished by introducing food mixtures into the formulation, which must enrich the finished products necessary for the human body substances: tomato powder, sunflower seeds, sesame seeds, cumin, corn flour, wheat gluten, dextrose, spices, etc. For example, the introduction of wheat germ into the formulation of bakery products not only raises their nutritional value, but also provides a beautiful appearance (Gunathilake et al., 2008; Do Carmo Barbosa Mendes De Vasconcelos et al., 2009).

New acidifying with rowan powder allowed to create accelerated rye-wheat bread technology and to get bread with high consumer properties. Therefore, the development of fast, natural and safe technologies is relevant task (Dubrovskaya et al., 2018; Dubrovskaya et al., 2019; Dubrovskaya et al., 2020).

When considering the characteristics, it can be argued that the addition of natural vegetable components to the recipe can enrich it with additional shades of taste and smell, change the color of soft part of bread and loaf heel, and also lead to changes in physical and chemical parameters (Arendt et al., 2007; Konopka et al., 2014).

**Research objective** is to carry out a technological evaluation of wheat flour mixture with herbal supplements and to determine their suitability for the production of bread, which will expand the range of bakery products.

## MATERIALS AND METHODS

Seeds of Midas soft wheat, used in the research, were planted on the experimental field of the farm 'Bodniuk' in v. Granyv of Gaysinsky district of Vinnytsia region (Ukraine).

For baking bread the following plants were used: *Chenopōdium quīnoa* L.; *Cyperus esculentus* L.; *Physalis tomentous* L.; *Cosmos sulphureus Cav.*; *Pycnanthemum virginianum* L.; *Pycnanthemum trifolium* L.; *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze*; *Agastache urticifolia* (Benth.) *Kuntze,* cv. Weide Kerze; *Mentha spicata* L. 'Moroccan'; *Achillea setacea Waldst. Et Kit.*; *Isodon japonicus* var. Glaucocalyx (Maxim.) *H. W. Li*; *Satureja montana* L.; *Teucrium scorodonia* L.; *Ruta montana* L.; *Népeta argolica Bory et Chaub.*; *Népeta grandiflora* L.; *Népeta mussinii Spreng. Ex Henckel.,* cv. Posviata Meisu; *Népeta nepetelia* L.

Plants were cultivated in the Northern part of the Right-bank Forest-Steppe of Ukraine at fields of the laboratory medical botany of the National botanical garden, named after M.M. Gryshko, NAS of Ukraine.

For preparing powder part of plants was used, comminuted in the laboratory mill up to 0.0001–0.1 mm and mixed for taking a recipe batch. And for preparing wheat flour, seeds of grain, were used; they were comminuted in the laboratory mill up to particle size 0.03–0.04 mm and mixed for taking a recipe batch.

Wheat flour was analyzed for the general content of protein by Kjeldahl N×5,7 using the device Kjeltec 2400–2460 (Foss Analytical, Höganäs, Sweden).

Moisture of flour and bread was determined using the device SESH-3M (ISC 'Mohyliv-Podylsky machine-building plant'); whiteness of flour - on the device Skib-M (SPE LTD 'Acoustic plus'); fall number - PCHP-5 (LTD 'MOTOTECH'); gluten quality - 'GDM-3M' ('Plavun-systems'); gluten vague - cabinet electric 'Voshod SHRE-2,1' ('Voshod').

The acidity of flour and bread was determined using the titration method. Sedimentation flour was carried out for Axford et al. (1979) and expressed in cubic centimeters.

Bread was baked in the laboratory stove (Brabender, 6 kW, 380 V). The volume of bread was estimated by displacing millet seeds using the device RZ-BIO (OSC Zagorsky optical-mechanical plant) and expressed in cubic centimeters for kg of bread.

**Experimental procedures**

The study was realized in the Uman National University of gardening, National botanical garden, named after M.M. Gryshko, NAS of Ukraine and production complex of the farm 'Bodnyuk' (Ukraine).

The analyses of flour and bread were realized with exactness and logical successiveness, according the methods, described in standards (given below).

The studies were guided by the standards method: flour organoleptic parameters - (SSU 46.004-99); quantity and quality of gluten - (SSU 4117; SSU ISO 21415-1; SSU ISO 21415-2; SS 13586); protein content - (SS 10846 and SSU-P-4117); fall numbers - (SS 27676-88; SS 30498); protein mass share - (SSU 4117; SS 10846); sedimentation - (ISO 5529); bread acidity - (SS 5670-96); bread porosity - (SS 5669-51); bread volume - (SS 5669); bread moisture - (SS 21094-75); laboratory bread baking - (SS 27669-88); organoleptic estimations of bread - (SSU-P 4585:2006; SS 5667-65).

The dough formulation was developed according to the method of state variety testing (Soroka et al., 2011). Parameters and regimens for keeping and baking bread of new recipes are selected as a result of experimental research. Powder and flour of plants were used to replace 0.5%, 2%, 5%, 10% and 15% of wheat flour.

The indicated dosage of comminuted studied plants to wheat flour was selected based on experimental studies. More detailed materials and methods for preparing and researching the quality of flour and bread of new recipes and physical and chemical parameters, organoleptic parameters are described in Osokina et al. (2017a, 2017b).

## RESULTS AND DISCUSSION

We analyzed wheat flour of Midas variety and mixtures of wheat flour with herbal supplements. The control sample had a taste characteristic of wheat flour, without odd-flavors, not sour, not bitter, when chewing crunch was not felt; the smell is characteristic of wheat flour, without odd-smells, not stale, not moldy; the color is white with a yellowish tinge. Samples with herbal supplements had a taste characteristic of wheat flour, with a taste of supplements, not sour, not bitter, when chewing crunch was not felt; the smell is characteristic of wheat flour with the smell of supplements, not stale, not moldy; the color of different tinges.

Table 1 shows the results of the evaluation of flour quality according to the main baking indicators.

**Table 1.** Parameters of the quality of wheat flour mixture with herbal supplements

| A mixture of wheat flour with herbal supplement (grain of Midas variety) | | Moisture, %, | protein content in terms of dry matter, % | Acidity of crumb, degrees | Fall number, s | Whiteness | |
|---|---|---|---|---|---|---|---|
| | | | | | | grade flour | con. un of Skib-M devic |
| Control | | 12.97 | 12.60 | 1.4 | 326 | BC | 56.3 |
| *Chenopōdium quīnoa* L. | 10% | **13.31** | 11.04 | 1.5 | 381 | 2 C | 22.6 |
| *Cyperus esculentus* L | 15% | **12.37** | 10.10 | 1.6 | 365 | 2 C | 22.0 |
| *Physalis tomentous* L. | 15% | **13.28** | *9.22* | 1.7 | **298** | 1 C | **37.0** |
| *Cosmos sulphureus Cav.* | 5% | **13.35** | 10.05 | 1.5 | 373 | 2 C | 12.1 |
| *Pycnanthemum virginianum* L. | 10% | **13.36** | *9.64* | 1.7 | **236** | 2 C | 25.4 |
| *Pycnanthemum trifolium* L. | 10% | **13.33** | *9.65* | 1.7 | **219** | 2 C | 21.0 |
| *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze* | 2% | 13.06 | 10.45 | 1.5 | 327 | 1 C | **37.1** |
| *Agastache urticifolia* (Benth.) *Kuntze,* cv. Weide Kerze | 2% | 13.08 | 10.46 | 1.5 | 356 | 2 C | 22.3 |
| *Mentha spicata* L. 'Moroccan' | 2% | 13.04 | 10.44 | 1.6 | **216** | 2 C | 12.2 |
| *Achillea setacea Waldst. Et Kit.* | 2% | 13.00 | 10.46 | 1.6 | 360 | 2 C | 17.0 |
| *Isodon japonicus* var. Glaucocalyx (Maxim.) H. W. Li | 0.5% | 12.97 | 10.66 | 1.4 | 382 | 1 C | **37.4** |
| *Satureja montana* L. | 2% | 13.02 | 10.47 | 1.5 | 343 | 1 C | **37.0** |
| *Teucrium scorodonia* L. | 2% | 13.04 | 10.44 | 1.5 | 319 | 1 C | **44.6** |
| *Ruta montana* L. | 2% | 13.07 | 10.45 | 1.7 | 321 | 1 C | **36.5** |
| *Népeta argolica Bory et Chaub.* | 2% | 13.00 | 10.45 | 1.6 | 376 | 2 C | 14.5 |
| *Népeta grandiflora* L. | 2% | 13.05 | 10.44 | 1.8 | 362 | 2 C | 16.0 |
| *Népeta mussinii Spreng. Ex Henckel.,* cv. Posviata Meisu | 2% | 13.04 | 10.46 | 1.6 | 384 | 2 C | 12.1 |
| *Népeta nepetelia* L. | 2% | 13.00 | 10.44 | 1.5 | 371 | 2 C | 12.1 |
| $IED_{05}$ | | 0.64 | 0.53 | 0.08 | 17.50 | - | 1.30 |

[1] Acceptable norm [SSU 46.004-99]: moisture not more than 15%; whiteness for the higher, 1st, 2nd grades not less than 54, 36–53, 12–35 conditional unit Skib-M device; the falling number is not less than 160 s; acidity for the higher, 1st, 2nd grades no more than 3.0, 3.5, 4.5 deg. [SS 27493–87].

As can be seen from Table 1, moisture of the experimental samples of flour ranged from 12.37–13.36%. It should be noted that samples of a mixture of wheat flour with plant supplements: *Mentha spicata* L. 'Moroccan', *Achillea setacea Waldst. Et Kit., Isodon japonicus* var. Glaucocalyx (Maxim.) *H. W. Li, Teucrium scorodonia* L.*, Satureja montana* L.*, Ruta montana* L.*, Agastache* and *Népeta* of different varieties., as well as isodon japonicus had a moisture content of about 13%, as in control sample. This can be explained by a small concentration of herbal supplement in the mixture of flour, only 0.5–2%.

In turn, the higher moisture was determined in a mixture of wheat flour with flour of *Chenopōdium quīnoa L.* seeds and in mixtures of wheat flour with *Physalis tomentous* L. and plants of *Cyperus esculentus* L.*, Cosmos sulphureus Cav., Pycnanthemums virginianum* L. and *trifolium* L. in comparison with the control sample of 3%. Whereas, a sample of a mixture of wheat flour with *Cyperus esculentus* L. powder had a lower moisture content than a control sample of 4.6%. This can obviously be explained by the moisture of plant supplements that are included in flour mixtures.

As a result of our research, we determined the mass fraction of protein, which was 12.6% in control sample, while in the other experimental samples it was 12–27% less. At the same time, however, the highest protein content is found in the sample with flour of *Chenopōdium quīnoa* - 11.04%, while the smallest with the powder of *Physalis tomentousPycnanthemum virginianum* and *Pycnanthemum trifolium* is 9.22–9.65%.

After analyzing the experimental samples for acidity, an increase in this index was recorded in comparison with the control at 7–22 degrees Neumann..

Also, we have carried out an analysis of the samples studied for the falling number. Thus, in control sample this indicator was 326 s. In mixtures of flour with *Teucrium scorodonia* L., *Ruta montana* L. and *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze*, the value of falling number was close to control sample - 319–327 s.

Whereas, in samples with herbal supplements of *Chenopōdium quīnoa* L.*, Cyperus esculentus* L.*, Cosmos sulphureus Cav., Agastache urticifolia* (Benth.) *Kuntze (cv. Weide Kerze), Achillea setacea Waldst. Et Kit., Isodon japonicus var. Glaucocalyx (Maxim.) H. W. Li, Satureja montana* L.*, Népeta argolica Bory et Chaub., Népeta grandiflora* L.*, Népeta mussinii Spreng. Ex Henckel.* (cv. Posviata Meisu), *Népeta nepetelia* L. this indicator exceeded the control version by 6–18%. In turn, in samples with herbal supplements of *Mentha spicata* L. 'Moroccan', *Pycnanthemum trifolium* L.*, Pycnanthemum virginianum* L.*, Physalis tomentous* L., the value of falling number is defined within the range of 216–298 s, which is 9–34% less than control sample.

It should be noted that in terms of whiteness the control variant corresponded to the highest grade with the value of 56.3 conditional units of Skyb-M device. The introduction of herbal supplements to the flour mixture reduced the value of Skyb-M device to the limits of the first grade (36.5–44.6 units) for samples with plants of *Physalis tomentous* L., *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze*, *Isodon japonicus* var. Glaucocalyx (Maxim.) *H. W. Li*, *Satureja montana* L., *Teucrium scorodonia* L. and *Ruta montana* L.; to the second grade (12.1–25.4 units) for samples with *Chenopōdium quīnoa* L.*, Cyperus esculentus* L.*, Cosmos sulphureus Cav., Agastache urticifolia* (Benth.) *Kuntze* (cv. Weide Kerze), *Achillea setacea Waldst. Et Kit., Mentha spicata* L. 'Moroccan', *Pycnanthemum* and *Népeta* of different varieties.

Gluten is an important baking indicator of flour, which promotes good volume, porosity and other characteristics of bread.

Table 2 shows such flour parameters as quantity, quality and blurring of gluten.

**Table 2.** Characteristic of gluten of wheat flour mixture with herbal supplements

| A mixture of wheat flour with herbal supplement (grain of Midas variety) | | Quantity of raw gluten, % | Gluten quality | | Blurring of gluten, cm |
|---|---|---|---|---|---|
| | | | group | units of GDM device | |
| Allowed norm (SSU ISO 46.004-99)[1] | | not less than 24.0/25.0/21.0 | I–II/ I–II/I–II | 45–100 | – |
| Control | | 26.24 | II | 85 | 12.0×12.0 |
| *Chenopōdium quīnoa* L. | 10% | **12.38** | I | 76 | **11.5×11.0** |
| *Cyperus esculentus* L. | 15% | **19.43** | II | 81 | **12.0×11.5** |
| *Physalis tomentous* L. | 15% | **10.23** | I | 68 | 10.5×10.0 |
| *Cosmos sulphureus Cav.* | 5% | **16.48** | I | 60 | 10.0×10.0 |
| *Pycnanthemum virginianum* L. | 10% | **14.28** | II | **32** | 9.0×8.5 |
| *Pycnanthemum trifolium* L. | 10% | **13.55** | II | **26** | 8.5×8.5 |
| *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze* | 2% | 21.04 | I | 64 | 10.5×10.0 |
| *Agastache urticifolia* (Benth.) *Kuntze, cv. Weide Kerze* | 2% | 19.60 | II | 78 | 11.0×11.0 |
| *Mentha spicata* L. 'Moroccan' | 2% | **24.24** | I | 75 | 10.5×11.5 |
| *Achillea setacea Waldst. Et Kit.* | 2% | **26.60** | I | 74 | 11.0×10.5 |
| *Isodon japonicus* var. Glaucocalyx (Maxim.) H. W. Li | 0.5% | 22.72 | I | 77 | 11.0×11.0 |
| *Satureja montana* L. | 2% | 22.60 | I | 67 | 10.5×10.5 |
| *Teucrium scorodonia* L. | 2% | **25.52** | I | 73 | 10.5×11.0 |
| *Ruta montana* L. | 2% | **25.48** | II | 78 | **11.0×11.5** |
| *Népeta argolica Bory et Chaub.* | 2% | 21.48 | I | 60 | 10.0×10.0 |
| *Népeta grandiflora* L. | 2% | 21.64 | I | 62 | 10.0×10.0 |
| *Népeta mussinii Spreng. Ex Henckel*., cv. Posviata Meisu | 2% | **25.68** | I | 75 | 11.0×11.0 |
| *Népeta nepetelia* L. | 2 % | **24.64** | I | 74 | 11.5×10.5 |
| $IED_{05}$ | | **1.04** | - | 3.38 | - |

[1] Under the line – superior quality; after the line – 1 and 2 quality.

Thus, the amount of raw gluten in control sample is 26.24%, which corresponds to the highest grade of flour, as well as in samples with herbal supplements of *Mentha spicata* L. 'Moroccan', *Achillea setacea Waldst. Et Kit., Teucrium scorodonia* L., *Ruta montana* L., *Népeta mussinii Spreng. Ex Henckel.,* cv. Posviata Meisu and *Népeta nepetelia* L.

*Samples with herbal supplements of Népeta grandiflora* L., *Népeta argolica Bory et Chaub., Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze, Isodon japonicus* var. Glaucocalyx (Maxim.) H. W. Li, *Satureja montana* L. are classified in the second grade by the amount of gluten, which we defined 21.04–22.72%. In the remaining samples, which were investigated, we washed away less than 21% of gluten (upholstered flour).

Blurring of gluten is an indicator that can further characterize the quality of flour and subsequently affect bread volume. Thus, samples of mixtures of wheat flour with vegetable food supplements of *Chenopōdium quīnoa* L., *Cyperus esculentus* L. and *Ruta montana* L. had blurring close to the control sample, in which this in dicator was 12×12 cm. In the remaining samples, the value of blurring of gluten was inferior to

control, at the smallest values for samples with *Pycnanthemum virginianum* L. and *Pycnanthemum trifolium* L., where this indicator was at the level only, respectively, 9.0×8.5 and 8.5×8.5 cm.

Indices of GDM device in terms of flour gluten quality correspond to the 2nd quality group and are characterized as a satisfactory weak gluten for control and samples with *Ruta montana* L., *Cyperus esculentus* L. and *Agastache urticifolia* (Benth.) *Kuntze*, whereas samples of flour with powder of *Pycnanthemum virginianum* L. and *Pycnanthemum trifolium* L., according to the value of device GDM, respectively, 32 and 26 units,are characterized by a satisfactory solid gluten. For the rest of the samples that were tested, the I group of gluten quality (good) was determined.

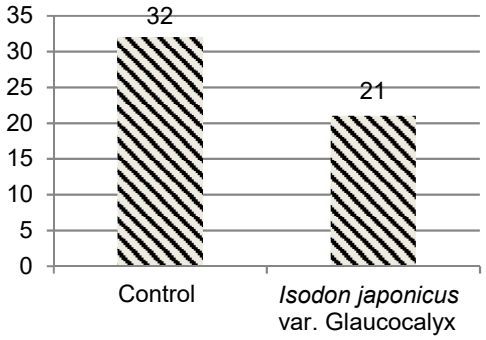


**Figure 1**. Sedimentation on the mixture of wheat flour with herbal supplements, $cm^3$ (0.5%).

Green test or sedimentation analysis using Green method is used to assess the quality and strength of flour made from soft wheat grains. The measurement method is based on the ability of the protein contained in the flour to swell in the acidic medium and is characterized by an index of sedimentation (the Green index), which allows determiningthe value of wheat and its intended use at the procurement stage (SSU ISO 5529:2014).

Grain with high degree of sedimentation is grain that is used to produce flour to obtain guaranteed good bakery products. In the world market, the indicator of sedimentation is of particular importance, both during export and import of cereals. Conversely, the indicator of slow sedimentation can determine the damage of flour by pests, such as the bug-shell.

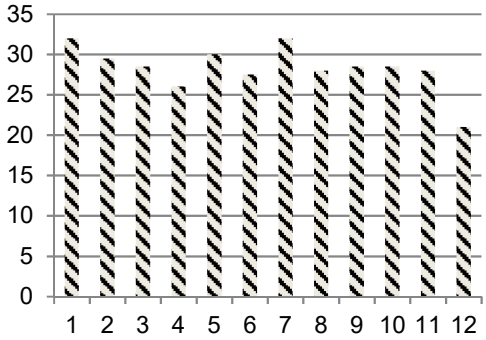


**Figure 2.** Sedimentation on the mixture of wheat flour with herbal supplements, $cm^3$ (2%):

1 – Control; 2 – *Agastache rugosa* (Fisch. & C.A. Mey.) *Kuntze*); 3 – *Agastache urticifolia* (Benth.) *Kuntze*, cv. Weide Kerze; 4 – *Mentha spicata* L. *'Moroccan'*; 5 – *Achillea setacea Waldst. Et Kit*; 6 – *Satureja montana* L.; 7 – *Teucrium scorodonia* L.; 8 – *Ruta montana* L.; 9 – *Népeta argolica Bory et Chaub.*.; 10 – *Népeta grandiflora* L.; 11 – *Népeta mussinii Spreng. ex Henckel.,* cv. Posviata Meisu; 12 – *Népeta nepetelia* L.

Figs 1–5 shows the results of our research on determining the index of sedimentation in the Green in the control sample of wheat flour of Midas variety and mixtures of such flour with plant additives.

Thus, unsatisfactory characteristic (10–18.5 $cm^3$) according to the given indicator were received by samples of flour with the addition of 10% of *Chenopōdium quīnoa* L., *Pycnanthemum virginianum* L. and *Pycnanthemum trifolium* L. and 15% of

*Cyperus esculentus* L. The rest of the samples are characterized by satisfactory values of sedimentation - 21–32 $cm^3$.

Consequently, Midas wheat flour and mixtures of flour with herbal supplements in almost all quality indices are in acceptable limits and correspond to the optimum level for obtaining high-quality bread.

We studied physical and chemical parameters of bread quality from Midas wheat flour (control) and new formulations with the addition of herbal supplements.

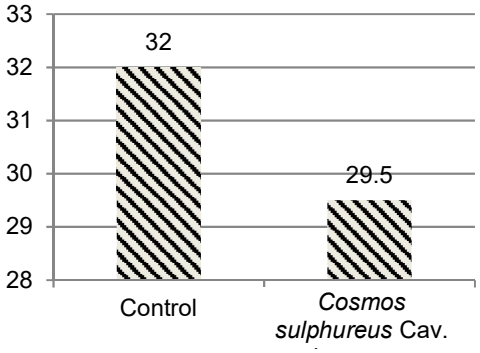


**Figure 3.** Sedimentation on the mixture of wheat flour with herbal supplements, $cm^3$ (5%).

The increase of acidity in the studied samples by 38–45% compared with the control and more intensive acid accumulation in the test samples of the test is due to the content of organic acids in this plant material and may be associated with the intensification of lactic fermentation, that is to be evidence of the creation of more favorable conditions for lactic acid bacteria.

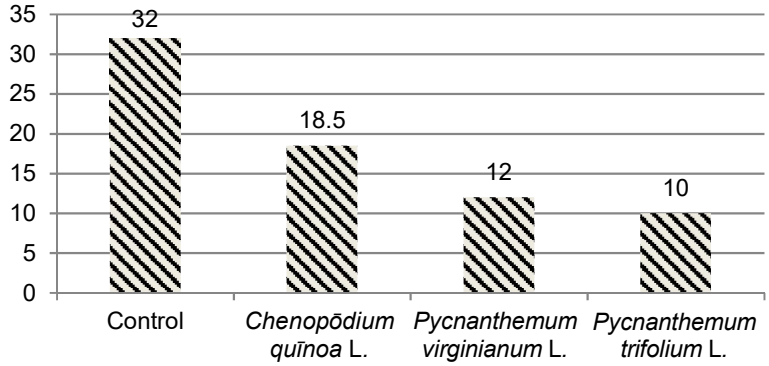


**Figure 4.** Sedimentation on the mixture of wheat flour with herbal supplements, $cm^3$ (10%).

The data obtained indicate that the use of supplements intensifies the process of fermentation of the dough. This is obviously due to the introduction of spice-like herbs in flour semis, as a nutrient medium: sugars, macro-, microelements, organic acids, substances that participate in the biosynthesis of the components of cellular metabolism and perform various functions in the metabolism of yeast cells.

According to organoleptic parameters, bread from wheat flour (control) meets the established requirements: the surface – smooth, without contamination, large cracks and blows; soft part of bread is baked, elastic, quickly restores its initial shape, is not sticky, not wet, with uniform porosity, without traces of hardening.

However, the quality of the bread of new formulations was somewhat different from the control sample: the color of soft part of bread - light and dark yellow, brown, green; taste and smell - are inherent to the added plants.

Powder of herbs has a pronounced color because it contains anthocyanin pigments.

The expediency of introducing powder into wheat dough in a dosage of up to 0.5% of *Isodon japonicus var. Glaucocalyx* (Maxim.) *H. W. Li*; up to 2% to the mass of flour of *Agastache rugosa and Agastache urticifolia*, *Mentha spicata* L. 'Moroccan'*, Achillea setacea Waldst. Et Kit., Satureja montana* L.*, Teucrium scorodonia* L.*, Ruta montana* L.*, Népeta* of different varieties; not more than 5% of *Cosmos sulphureus* Cav., *Chenopōdium quīnoa* L., *Pycnanthemum virginianum* L. *and trifolium* L., *Cyperus esculentus* L.*, Physalis tomentous* L.; up to 10% of *Chenopōdium quīnoa* L., *Pycnanthemum virginianum* L. *and Pycnanthemum trifolium* L.*, Cyperus esculentus* L.*, Physalis tomentous* L.; up to 15% of *Cyperus esculentus* L.*, Physalis tomentous* L., since it was with these doses that the bread was evenly colored from light yellow, green to dark brown crust without distructions and cracking, elastic soft part of bread, thin-walled porosity, pronounced bread taste and pleasant aroma of supplements unlike other prototypes.

In new samples of bread in the soft part of bread there were visible particles of enriching supplement, the presence of which during the preparation of dough, obviously, negatively affected the structure and properties of gluten dough frame.

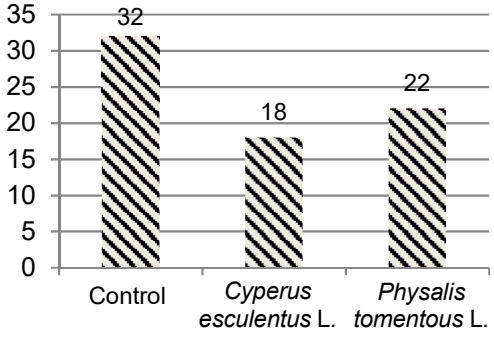


**Figure 5.** Sedimentation on the mixture of wheat flour with herbal supplements, $cm^3$ (15%).

On average, general bread-making evaluation of wheat bread is 4.5–5.0 points (excellent) - with the addition of up to 15% of *Cyperus esculentus* L., *Physalis tomentous* L.; up to 5% of *Cosmos sulphureus Cav.*; up to 2% of *Satureja montana* L. and *Ruta montana* L., *Agastache rugosa* and *Agastache urticifolia* (Benth.) *Kuntze*, as well as in control; 3.8–4.2 points (good) - with the addition, of up to 10% of *Chenopōdium quīnoa* L. and *Pycnanthemum* L.; up to 5% of *Népeta mussinii Spreng. Ex Henckel., Achillea setacea Waldst. Et Kit.*; up to 2% of *Népeta nepetelia* L.; up to 0.5% of *Isodon japonicus* and 3.0–3.7 points (satisfactory) - for the rest of the samples.

## CONCLUSIONS

It should be noted that, according to baking indicators, the flour mixture that has been tested has good value. Thus, the value of falling number is determined within the limits of 214–384 s, acidity - 1.4–1.8%, whiteness - up to 37.4 standard units of Skyb-M device. The moisture of the experimental samples of flour varied within the limits of 12.37–13.36%, and the value of protein in flour mixtures with herbal supplements - 9.22–11.04%, which is less than control by only 12–27%.

The amount of raw gluten in control sample is 26.24%, which corresponds to the highest grade of flour, as well as in samples with herbal supplements of *Népeta mussinii Spreng. Ex Henckel.* (cv. Posviata Meisu) and *Népeta nepetelia* L., *Mentha spicata* L. *'Moroccan'*, *Achillea setacea Waldst. Et Kit., Teucrium scorodonia* L., *Ruta montana* L. In samples with herbal supplements of *Chenopōdium quīnoa* L.*, Cyperus esculentus* L.*,*

*Physalis tomentous* L.*, Cosmos sulphureus Cav., Pycnanthemum virginianum* L. *and Pycnanthemum trifolium* L. *Agastache urticifolia* (Benth.) *Kuntze* (cv. Weide Kerze) less than 21% of gluten was washed out.

The compliance of gluten quality of all studied samples with standard norms for wheat flour was determined, and first and second groups of gluten quality were established, which are characterized as satisfactory hard, good and satisfactory weak.

It was recorded that samples of flour with powder of *Pycnanthemum virginianum* L. and *Pycnanthemum trifolium* L.*,* according to the value of GDM device, respectively, 32 and 36 units, are characterized by a satisfactory solid gluten, at the same time they had the least blurring of gluten, respectively, 9.0×8.5 and 8.5×8.5 cm, as well as unsatisfactory index of sedimentation, respectively, 12 and 10 $cm^3$.

Thus, use of potherbs in bakery production is promising. We have established the effectiveness of using herbs in the technology of bakery products, as a nutrient enrichment agent and nutrient medium for yeast, which in turn was reflected as finished products. In order to develop an effective technology for its use, creating new types of products with properties that meet the current needs of consumers in Ukraine and the world, it is necessary to clarify the relation of potherbs with other components.

It is advisable to include powder in wheat dough in a dosage of 0.5% of *Isodon japonicus var. Glaucocalyx* (Maxim.) *H. W. Li* to the mass of flour; up to 2% of *Agastache rugosa and Agastache urticifolia*, *Ruta montana* L., *Satureja montana* L., *Népeta nepetelia* L., *Népeta mussinii Spreng. ex Henckel.* (cv. Posviata Meisu); not more than 5% of *Cosmos sulphureus Cav.*; up to 10% of *Chenopōdium quīnoa* L., *Pycnanthemum virginianum* L. *and Pycnanthemum trifolium* L.; up to 15% of *Cyperus esculentus* L. and *Physalis tomentous* L., as it is with these dosages that the bread was evenly colored from light yellow, green to dark brown crust without destructions and cracking, elastic soft part, thin-walled porosity, pronounced bread taste and pleasant aroma of supplements unlike other prototypes.

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