Study of quality indicators of developed bakery products during storage

N N Shmatkova and A A Kurochkin

Penza State University of Technology, Baidukova /st. Gagarin, 1 a/11, Penza, 440039, Russia
E-mail: n.shmatkova2014@List.ru

Abstract. The development of the bakery products enriched with food fibers, polyunsaturated fatty acids, phytalbumin, mineral substances and also vitamins and flavonoids (Silymarinum) through the use of extruded mixture of holy thistle seeds and wheat grain is considered in the article. The mixture of holy thistle seeds and wheat grain in the ratio of 1:4 was processed for 10-15 seconds at a temperature of 100-105 °C by means of the modernized one-screw press extruder (CMH - 2U).

1. Introduction
The bases of state policy of the Russian Federation in the field of healthy food of the population as the priority purpose provide preservation and promotion of health of the population, prevention of the diseases caused by poor and unbalanced nutrition, forming of a healthy lifestyle of citizens of the country. Therefore key tasks of the food industry are connected with increase in production of different types of new foodstuff of the set chemical composition and properties. Among them the functional, first of all enriched, foodstuff and also specialized foodstuff, in particular products of dietary clinical and dietary preventive foods [1].

The relevance of the extruded composite mixture is due to the following positions:
- Variety of food products produced by extrusion technology;
- High economic efficiency of producing extruded products (continuous process of processing starch-containing components into finished products with complex action of high values of temperature and pressure, low moisture content and relatively short time) [2].

Bakery products are an indispensable and mandatory part of a person’s diet. In market economy and competition the requirements for the quality of products have increased. One of the directions is the production of bakery products with extended shelf life [3].

The aim of the work is the research of influence of extruded composite mixture of holy thistle seeds and wheat grain (EX) on extension of storage lives of the developed bakery products.

At present, researchers consider the inclusion in the human diet of products enriched with food fibers and minerals of grain extrudates to be the most affordable way to mass improve the provision of necessary nutrients to the population [4].

By applying various extrusion treatment modes, it is possible to achieve efficient modification of basic biopolymers of food raw materials, and regulation of protein and carbohydrate complex of cereals.
2. Materials and methods

– The extruded mixture of holy thistle seeds and wheat grain (EX) produced on a one-screw press extruder (KMZ-2U) equipped with the vacuum chamber;

– Wheat flour of the premium grade (GOST P 52189-2003);

– Pressed baker’s yeast (GOST P 54731 - 2011).

Conventional and special methods of determining organoleptic, physicochemical indices of quality of raw materials and finished products were used in the work.

In order to achieve the objective, the tasks of determining the chemical composition of the extrudate of the mixture of holy thistle and wheat grain (1:4), assessing the properties of the mixture of holy thistle and wheat grain, as well as the finished products according to standard methods were set.

3. Results and discussion

The extruded mixture of holy thistle seeds and wheat grain produced on the one-screw press extruder (KMZ-2U) equipped with the vacuum chamber was used in the work. The mixture of holy thistle seeds and wheat grain was processed in the ratio of 1:4 for 10-15 seconds at a temperature of 100-105 °C [4].

In order to justify the practicability of using holy thistle seeds and wheat grain extrudate (EX) in the technology of wheat bread varieties, its organoleptic and physicochemical properties were determined at the first stage of research.

When studying the chemical composition of prime grade wheat flour and EX, the following parameters were determined: humidity, ash content, protein content, fiber content, nitrogen-free extractive substances.

The results of the comparative analysis of the chemical composition of prime grade wheat flour and EX are given in Table 1.

| Indicator Name                        | Flour wheat Of extra class | EX   |
|---------------------------------------|-----------------------------|------|
| Mass fraction of moisture, %          | 14.5                        | 7.8  |
| Protein mass fraction, % CB           | 12.3                        | 15.7 |
| Fat mass fraction, % CB               | 1.3                         | 8.65 |
| Mass fraction of fiber, % CB          | 0.2                         | 7.35 |
| Mass fraction of ash, % CB           | 0.6                         | 2.94 |
| Nitrogen-free extractive substances, % CB | 85.6                      | 65.36 |

The moisture content of EX is low (7.8%), which results in high retention of the extruded mixture.

EX contains a higher percentage of crude protein (15.7%) compared to the protein content of prime grade wheat flour (12.3%), indicating a high potential of EX as a source of protein enrichment for food products.

The mass fraction of fat in EX is 8.65%, which is 7.4 times higher than the specified value in wheat flour. A high fiber content in EX was found to be 7.35%, and ash was found to be 2.94%.

Content of nitrogen-free extractive substances in EX is 1.3 times less than in wheat flour.

One important indicator of the quality of bakery products is the preservation of freshness during storage [5].

At the second stage, the effect of storage duration on the quality of the developed bakery products - bread "Zdorovyak" with holy thistle in comparison with bread from prime grade wheat flour (control) was studied.
Freshness of bakery products was estimated according to their structural and mechanical properties by pressing on the surface of the whole product. The degree of deformation during pressing, biting, following chewing and swallowing was evaluated.

In this regard, the studies were carried out on the effect of storage time on the quality of the developed new types of bread “Zdorovyak” with holy thistle compared to bread from prime grade wheat flour (control). Bakery products were packed in polyethylene film and stored in a clean, dry, well ventilated room on shelves laid in one row at 20 ± 2 °C and relative air humidity no more than 75%. The shelf life of bakery products was 72 hours.

During 3 days of storage bakery products were examined on organoleptic and physical-chemical indices, namely by humidity indices.

![Figure 1. Change of bakery products humidity during storage](image)

During 72 hours of storage, the humidity of “Zdorovyak” bread from the melt decreased from 43.6 to 42.8% (by 1.84%), and the humidity of the control sample decreased from 43.0% to 41.7% (by 3.03%).

It was found that during storage, the loss of freshness of the control sample of bread from prime grade wheat flour (control) was more intense than that of the sample of bread “Zdorovyak” with a thistle dosage of 5%. In addition, an important indicator of the degree of freshness of bread is its crumbling. The crumbling of bread is associated with the transition of the gelatinized starch to the original state, in which its individual grains are reduced in volume and air layers are formed around them. Thus, the drier the bread the higher the crumbling index. According to the results of the analysis, it was found that the crumbling of the “Zdorovyak” bread with thistle on average decreases in comparison with the control after 24 hours of storage by 23.5%.

Organoleptic assessment (point assessment of bread quality according to the value of the main indicators) of “Zdorovyak” bread with thistle and control sample is given in Figure 2.
4. Conclusions

The use of the extruded mixture of thistle seeds and wheat grains enables to obtain functional products enriched with food fibers, protein, PHHC and mineral components. Based on the results of the experiment, a rational dosage of the extruded mixture should be considered 3-5% of the total weight of the flour.

Thus, introduction of extrudate of mixture of holy thistle seeds and of wheat grain (1:4) promotes extension of maintaining freshness of “Zdorovyak” bread with a holy thistle i.e. slows down the process of bread hardening.

Bakery products with extruded mix of seeds of a thistle and seed of wheat have high tastes, original color and aroma, the increased nutrition value. They will be demanded in the market.

References
[1] The strategy of improvement of quality of food products in the Russian Federation 2016 1364-r
[2] Shmatkova N N and Voronina P K 2015 Perspectives of use of composite mix in technology of bakery products of functional purpose The Innovation equipment and technology 3 (04) 33-39
[3] Kolmakov Yu V, Zelova L A and Pakhotina I V 2015 Bread from composite flour mixtures Journal of the Altay State Agrarian University 4 (126) 133-136
[4] Kurochkin A A and Frolov D I 2015 Polikomponentny extrudate on the basis of seed of wheat and seeds of a thistle spotty News of the Samara state agricultural academy 4 76-81
[5] Kurochkin A A, Voronina P K, Shaburov G V and Frolov D I 2016 Extrudates from vegetable raw materials with increased content of lipids and food fibres *Technology and technology of food production* 3 (42) 104-111

[6] Kurochkin A A, Voronina P K and Shaburov G V 2017 *Theoretical justification of the use of extruded raw materials in food technologies* (Moscow: INFRA-M)

[7] Shaburova G V, Voronina P K, Shabnov R V, Kurochkin A A and Avrorov V A, Ru, Patent No 2014125348/13 (10 July 2015)

[8] Rodionova N S, Popov E S, Maltseva M V and Fomicheva A V 2014 Development of technology of food systems based on complex products deep processing of vegetable raw materials *Current biotechnology* 3 (10) 8-11