

The use of pectin extracts from chaenomeles fruits in bakery

Natalia Sokol, Nadezhda Sanzharovskaya*, and Olga Khrapko

Kuban State Agrarian University, 13, Kalinina str., Krasnodar, 350044, Russia

Abstract. Currently, an urgent task is the creation of food products with directed biological activity through the use of natural ingredients. The mass consumption of bread gives reason to consider it as a product with exceptional potential and significance for improving the quality of nutrition and protecting the organism from the effects of harmful environmental factors. The aim of the research is to study the chaenomeles fruits, to determine the rational parameters for obtaining pectin extracts and to evaluate their effect on the baking properties of flour, the course of the technological process and the quality of finished bakery products. The objects of the research were chaenomeles fruits; pectin extracts; wheat flour; prototype bread samples. It has been studied the kinetics of pectin substances extraction and has been proposed the process rational parameters, which make it possible to obtain extracts with high functional and technological properties. It is shown that the addition of pectin extract from chaenomeles fruits at a dosage of up to 15 % improves the quality characteristics of bread. The proposed recipe allows obtaining high-quality enriched bakery products.

1 Introduction

In recent decades, the demand for enriched food products has increased significantly in the world, which is caused by objective reasons such as stress, negative environmental influences. In Russia, one of the first places among food products is traditionally occupied by bread and bakery products, so the issue of enrichment of this particular group of products is of great importance. At the same time, problems with the quality of the main raw material are forcing the bakery companies to increasingly turn to the use of food additives – improvers and preservatives [1].

In this regard, it arises the question of searching for natural multi-purpose ingredients that can provide both the technological improvement in the products quality and the increase in the biologically active substances content. From these positions, it is promising wild-growing fruit raw materials, which are characterized by a complex of valuable physiological properties and technological functions. [2-4].

Considering the rich chemical composition of wild-growing fruit raw materials, the following areas of its use can be distinguished:

- the content of the biologically active substances natural complex, high biological and

*Corresponding author: hramova-n@mail.ru

physiological activity allow us to recommend its use in the obtaining of food products with high nutritional value, functional, dietary, therapeutic and prophylactic [5-6];

- the high content of pectin substances with radioprotective properties indicates the possibility of using this raw material when creating bakery products with special protective properties and regulating the state of the protein-proteinase complex of wheat flour;

- the presence of bactericidal and bacteriostatic components makes it possible to consider wild-growing fruit raw materials as an effective tool for improving the biotechnological properties of semifinished products during the technological process conduction and the microbiological condition of finished products during storage [7].

Among the wide variety of wild-growing and cultivated plant raw materials, of great interest are the chaenomeles fruits, which are rich in pectin, vitamins, organic acids, can be used by patients with diabetes mellitus type II in therapeutic and preventive nutrition and also have a pleasant aroma [8-11].

The aim of the research is to study the chaenomeles fruits as a raw material with valuable chemical composition, to determine the rational parameters for obtaining pectin extracts and to evaluate their effect on the baking properties of wheat flour, the course of the technological process and the quality of finished bakery products.

Realization of the set aim necessitated the solution of the following objectives:

- study the chemical composition of the chaenomeles fruits;
- determine the rational parameters for obtaining pectin extract;
- evaluate the effect of pectin extract on the state of protein-proteinase and carbohydrate-amylase complexes of wheat flour;
- investigate the additive effect on the technological process course and the bakery products quality.

2 Materials and methods

The objects of study were the chaenomeles fruits; pectin extracts obtained under laboratory conditions; baking wheat flour of the first grade; bread prototype samples.

For research, the following species of chaenomeles fruits were used: *Chaenomeles Japonica* (Lindl.), *Chaenomeles Maulei* (C.K. Schneid.), *Ch. Sinensis* (Koch.), *Chaenomeles Superba*. The fruits were harvested at the stage of customer maturity at the end of September. The fruits corresponded to their biological characteristics, differed in color from light yellow to yellow, had a characteristic sour, slightly tart taste and pleasant aroma. The determination of the biochemical composition and quality indicators of the objects of study was carried out according to the methods generally accepted in the food and processing industry, table 1.

Table 1. Quality indicators of chaenomeles fruits

The objects of study	Dry substances content, %	Reducing substances content, %	Titratable acids content, %	Vitamin C content, mg/100 g of raw material	Pectin substances content, % on raw material		
					Soluble pectin	Insoluble pectin	Total pectin
Ch. Maulei	7,8±0,05	5,45±0,07	3,6±0,1	48,3±1,2	0,420±0,01	0,55±0,01	0,97±0,01
Ch. Japonica	10,8±0,10	8,10±0,05	4,3±0,2	70,9±2,1	0,425±0,01	0,80±0,02	1,22±0,01
Ch. Superba	10,7±0,08	7,95±0,04	4,9±0,1	64,7±1,5	0,430±0,01	0,65±0,00	1,08±0,01
Ch. Sinensis	9,7±0,06	6,65±0,03	4,2±0,2	144,1±2,2	0,395±0,01	0,55±0,02	0,94±0,01

The fruits of studied chaenomeles species were characterized by a high level of

accumulation of ascorbic acid, high acidity, sufficient sugars and dry substances content and can be used for processing [12].

In the study, baking wheat flour of the 1st grade was used (moisture content – 14,0 %; raw gluten content – 30,2 %; gluten quality – 100 arbitrary units).

Bread prototype samples were prepared in straight dough method, using the test laboratory baking method.

The quality of the finished bread was evaluated by indicators: acidity, porosity, dimensional stability and specific volume.

3 Results and Discussions

The main problem that arises when enriching bakery products with fruit natural additives is to ensure the appearance and taste of products familiar to the customer. Therefore, hydrolysis-extraction was chosen as a rational way to prepare fruit raw materials, which will allow isolating a complex of biologically active substances and removing unwanted impurities.

When determining the rational parameters for the preparation of fruit raw materials, the extraction process was carried out by changing the following:

- type of extractant (citric, oxalic, acetic, lactic acid);
- temperature (60, 70, 80, 90 °C);
- extractant concentration (0,1, 0,2, 0,3, 0,4, 0,5 %);
- extraction duration (60, 90, 120, 150, 180 min);
- extractant volume ratio (1 : 3, 1 : 4, 1 : 5, 1 : 6).

The most commonly used types of extractants, namely: alkalis, alcohols, even if they are subsequently extracted from the extract, are not desirable for use in the food industry, therefore, in current research, citric, oxalic, acetic and lactic acids were used as extractants [13].

Studies of organoleptic indicators found that the best extractant for obtaining pectin extract from chaenomeles fruits is citric acid. The results of the study of other extraction parameters on the kinetics of the process are presented in table 2.

According to the results of experimental studies, the following extraction conditions for chaenomeles fruits were selected: extractant - citric acid; extractant concentration - 0,4 %; extraction temperature – 80 C; extraction time - 180 min; extractant volume ratio – 1 : 5. These process parameters make it possible to obtain a complex of valuable chemicals in the extracts and provide them with functional and technological properties, which, according to theoretical data, should have a positive effect on the state of the protein-proteinase complex of wheat flour with weak gluten [1, 13]. Pectin extracts from chaenomeles fruits, obtained under such extraction conditions, were characterized by the following indicators: dry substances – 2,6 %; pH – 3,02 ; pectin substances yield – 4,23 % on absolutely dry mass; purity – 0.18.

The quality of finished bakery products is closely related to the quality of flour. In the course of further studies, the effect of the extract from chaenomeles fruit on the baking properties of wheat flour was determined. Evaluation of the effect of pectin extract from chaenomeles fruits on the properties of flour is presented in table 3.

The conducted studies confirm that the addition of the pectin extract from chaenomeles fruits strengthens gluten and indicates the possibility of using these additives in the technology of bakery products from flour with weak gluten.

The assessment of the effect of the chaenomeles fruit extract on the carbohydrate-amylase complex of flour was determined by the change in the indicator of the gas-forming ability of the flour. With adding of extract from chaenomeles fruits in amount of 10 % by dough mass, the intensity of gas formation of wheat flour increased by 16,9 %, compared

with the control sample, which is a prerequisite for reducing the fermentation time of the dough.

Table 2. The influence of extraction parameters on the physicochemical parameters of pectin extract from chaenomeles fruits

Extraction parameter	Pectin extract		Alcohol-precipitated pectin substances yield, % by absolutely dry mass
	Dry substances content, %	Purity	
Temperature:			
60 °C	2,2	0,11	2,56
70 °C	2,4	0,13	3,57
80 °C	2,6	0,15	4,23
90 °C	2,7	0,14	3,94
Extractant concentration:			
0,1 %	2,0	0,11	2,44
0,2 %	2,2	0,12	2,98
0,3 %	2,4	0,13	3,12
0,4 %	2,6	0,15	3,63
0,5 %	2,7	0,15	4,04
Extraction duration:			
60 min	1,7	0,12	2,32
90 min	1,9	0,15	2,56
120 min	2,3	0,14	3,02
150 min	2,6	0,15	3,48
180 min	2,8	0,15	4,12
Extractant volume ratio:			
1 : 3	3,4	0,10	3,21
1 : 4	2,8	0,15	4,12
1 : 5	2,4	0,15	3,95
1 : 6	2,0	0,12	3,01

Table 3. Effect of chaenomeles fruit extract on the baking properties of wheat flour

Indicator name	Additive amount, % by flour weight				
	0	5	10	15	20
Gluten content, %	30,2±0,02	30,4±0,04	30,0±0,01	29,8±0,05	29,7±0,03
Gluten quality, arbitrary units	100±1,2	95±0,9	90±1,1	85±1,3	75±0,8
Gluten extensibility, mm	190±3,2	185±2,4	180±3,1	172±4,0	165±2,9
Carbon dioxide release, sm ³ of CO ₂ /100 g	1112±5,6	1250±7,8	1300±6,3	1250±5,9	1215±7,3

The main indicator characterizing the readiness of semi-finished flour products – sponge and dough, is titratable acidity. During the studies, a rapid increase in acidity was established during the fermentation of semi-finished products containing extracts, and after 120-150 minutes the final acidity of the dough was achieved in accordance with the requirements of technological instructions.

Next in order to establish maximum possible dosage of pectin extract wheat bread prototype samples were obtained with the addition of various amounts of pectin extract from chaenomeles fruits.

The organoleptic evaluation showed that the most preferred indicators had the finished

products, which were obtained by adding 15 % of pectin extract on flour weight. At the same time, the organoleptic indicators remained familiar to the customer – evenly colored crust, light crumb and the absence of foreign flavors and aroma.

The adding of the extract from chaenomeles fruits improves a number of indicators of bread – specific volume, dimensional stability and porosity, table 4.

Table 4. Influence of extract from chaenomeles fruit on the quality of bakery products

Indicator name	Additive amount, % by flour weight				
	0	5	10	15	20
Specific volume, $\text{sm}^3/100 \text{ g}$	295±5,2	308±4,3	315±4,8	318±5,3	310±5,1
Dimensional stability	0,27±0,01	0,31±0,02	0,36±0,01	0,38±0,01	0,35±0,02
Porosity, %	68,0±1,1	72,0±1,0	75,0±0,9	75,0±1,2	72,0±1,0
Acidity, deg.	2,2±0,1	2,6±0,1	2,8±0,1	3,0±0,2	3,4±0,1

It was found that the specific volume of bread with the addition of pectin extract from chaenomeles fruits increases by 4,4-7,8 % compared to the control, the porosity of crumb – by 5,9-10,3 %, the shape stability of hearth bakery by 14,8-40,7 %. The best quality indicators were distinguished by bread prototype samples prepared with the addition of pectin extract from chaenomeles fruits in an amount of 15 % by flour weight.

It is shown that the use of pectin extract from chaenomeles fruits reduces overall microbiological contamination of bread and provides rope spoilage prevention [14-15].

And also the results obtained allows to conclude that the use of pectin extract from chaenomeles fruits in the technology of bakery products from yeast dough gives the finished product high detoxifying properties, fig. 1.

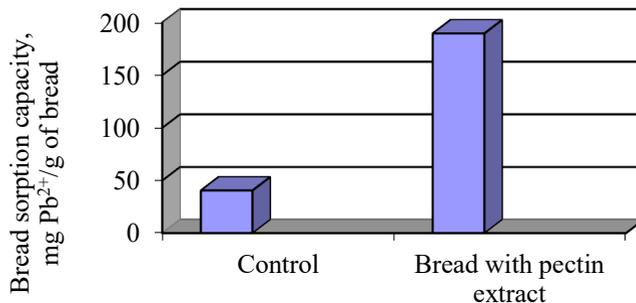


Fig. 1. Bread sorption capacity

Thus, the proposed recipe correction makes it possible to obtain high-quality bread, which, due to its sorption capacity, can be recommended as a prophylactic product.

4 Conclusion

Based on the data obtained, the expediency of adding pectin extract from chaenomeles fruits in amount of 15 % in the wheat dough recipe was proved. The pectin extract from chaenomeles fruits has a high potential for baking in terms of solving a number of industry problems associated with processing of wheat flour with weak gluten and improving bakery products quality. Along with this, the use of the extract makes it possible to intensify the dough maturation process, and makes it possible to obtain products that are more resistant to microbiological spoilage.

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