Annals of Agrarian Science 15 (2017) 177–180

Contents lists available at ScienceDirect

Annals of Agrarian Science

journal homepage: http://www.journals.elsevier.com/annals-of-agrarian-science

Development of new-generation dietary bread technologies by using soya processing products

M.A. Silagadze*, S.T. Gachechiladze, E.G. Pruidze, G.S. Khetsuriani, Kh.B. Khvadagiani, G.N. Pkhakadze

Akaki Tsereteli State University, 59, Tamar Mepe Str., Kutaisi, 4600, Georgia

ARTICLE INFO

Article history:
Received 12 December 2016
Accepted 15 March 2017
Available online 10 May 2017

Keywords:
Wheat bread
Soya flour
Soya milk
Sprouting
Glycemic index

ABSTRACT

In order to develop low-calorie high-biological value dietary bread, we used the soya processing products – roasted full fat soya flour, soya milk and soya pomace. There has been studied their chemical and micro nutrient composition. The study shows that the soya processing products have low energy and high biological value, and exhibit low glycemic index that makes them very attractive for the design of dietary food products. In order to increase bioavailability of soya, we carried out its sprouting. We studied the impact of different technological factors on the accumulation dynamics of highly digestible components of soya. based on the studies of the separate and complex influence of the soya processing products on the quality of whole wheat bread, there have been determined the optimal doses of food additives. There has been developed a new-generation dietary product with the trade name "Our Daily Bread", as well as its making technology.

Introduction

Increasing the biological value and assignment of functional profile is one of the priority areas in the design of a new-generation dietary products that that can be achieved through: the use of raw materials and ingredients rich in biologically active and physiologically useful substances; the modification of carbohydrate, fatty acid and aminoacid compositions of raw materials and ingredients that will ensure achieving the optimal balance the between physiologically useful components; the use of food additives of natural origin, which have a positive impact on the human body in metabolism and meet the modern requirements of adequate nutrition. The mentioned additives must be safe, therefore, when developing them, it is necessary to define their assignment, useful properties, functionality and safety. The issue of providing of production with regional raw material resources is especially relevant [1–5].

Development of functional food additives based on cereal, leguminous and oil-bearing crops and their processing secondary resources, is important and relevant enough. The mentioned problem, to a certain extent, can be solved by using the soya processing products. In this perspective, our research was aimed at developing technology of a new-generation low-caloric, low-glycemic dietary bread of high biological value by using functional food additives, such as the soya processing products.

Objectives and methods

The subjects of the research were the samples of soya grains gown in peasants' holdings in different districts of Georgia from 2014 to 2015. Particularly: Imeretian soya – from Tskhaltubo and Samtredia districts; Gurian soya – from Lanchkhuti district and Chiatura's soya. Also, the subjects of the research were soya flour, soya milk and dietary bread.

When determining the basic quality parameters of raw materials, semi-finished products and finished products, we used generally accepted standard and special methods and devices [6–9].

We determined humidity by batch weight drying by method of bringing to a constant weight; to determine the content of proteins, we used the Kjeldahl's method; the fat content was determined by the extraction method using a Soxhlet type apparatus; the content of the reducing sugars was determined by the micro-method of K.N. Chizhova and A.N. Sonkina; the content of micro-nutrients – by liquid chromatography; titrable acidity of dough – by the titration-based method; rheological properties of dough (dough

* Corresponding author.
E-mail address: mariasilagadze@yahoo.com (M.A. Silagadze).
Peer review under responsibility of Journal Annals of Agrarian Science.

http://dx.doi.org/10.1016/j.aasci.2017.05.018

rising, the amount of carbon dioxide emitted during dough fermentation, and its preventing capacity) were determined in a reofermentometer F3 [6].

Dough-making was carried out in the laboratory. The wheat dough was made by using straight dough method.

Physical-chemical and organoleptic characteristics of the quality of baked goods were determined in accordance with the standard methodologies [7–9]. There have been determined humidity, acidity, porosity and specific volume of bread.

Results and analysis

Proceeding from the set goals, taking into account natural resources of Georgia, we have focused on a rich in proteins leguminous crop – soya. During the experiment, as the functions additives, we used the soya processing products – roasted soya flour, soya milk, soya pomace or the so-called "okara", as well as the sprouted soya grain.

In order to obtain the high biological value products with a balanced composition, we have carried out purposeful modification of soya grain. To that end, we have used one of the promising and safe methods – the method of enzymatic modification. The method is based on the activation of the own endo-enzymatic system, which passes in a humid environment when grain begins sprouting. During the mentioned experiments, we have used the grain of Gurian soya of the 2015 harvest from Lanchkhuti district of West Georgia. As the control sample (for comparing) we chose the wheat grain.

At the initial stage of the study, we implemented sprouting of grain, for which, we picked the grain out, and then we removed alien impurities and damaged grains. Then we held it in the water and removed the "dead" grains, those which have come to the surface. Then we washed it several times and irrigated with potassium permanganate solution for disinfection. After sorting, disinfection and washing, the grain was placed as thin layer in a broad container and soaked in the water, so that water covers each grain. The container was placed in a thermostatat the temperature of 25 °C. 8 h later, the grain was washed and covered with wet and moist gauze. In order to ensure that the grain has not been dried, we covered the container with the lid, left openings to keep grains breathing and watched how sprout appears. At the end of the second day, the control wheat grain markedly, but soya grain – at the end of the third day. The sprouted soya grain is illustrated in Fig. 1.

The grain was germinated until the 2 ÷ 5-mmsprouts were obtained, and only then, we were taking samples for performing chemical analysis. Then we determined the following parameters: overall quantity of water, proteins, lipids, carbohydrates, and dietary fibers (Figs. 2 and 3). To assess biological value, there has been determined the content of vitamins, micro- and macroelements (Table 1).

Observations on sprout length variations revealed the optimal terms of grain sprouting, which are as follows: for wheat - 48÷60 h, for soya - 60÷72 h. According to the recommendations available in the literature, the length of sprout used for human consumption should not exceed 2÷5 mm.

Energy value of soya grain after sprouting was 135,9 kcal (Table 2).

There has been studied the impact of different factors (temperature, soaking duration, irrigating modulus – correlation of grain and water during soaking, splash ratio) on soya grain sprouting process. During the period of sprouting, we were determining the quality of germination of grain and germination energy. The degree of germination is determined by the ratio of sprouted grains to their initial quantity (%). And germination energy is a speed of germination as a percentage of the quantity of these grains, which produced sprouts over the time required for testing (from 3 to 15 days). It has been established that the degree of germination of grain was 85%. As a result of the experiments, the optimal modes have been revealed as follows: the temperature of 25 ÷30 °C, subsequent 40%-rise of which did not affected germination process, the optimal irrigating modulus made up 1 share of grain – 2-2,4 share of water; splash ratio is 3–4 times daily; soaking duration – 6 h (with several washes).

We studied the impact of the selected additive on the properties of dough and the quality of finished products. We used the most tested in the production method – straight dough procedure. We varied the quantities of the additives, added them into the dough in the following proportions: soya pomace - 5, 10, 15, 20 and 30% by mass of flour. We varied the quantity of water required for dough-making with 25, 50, 75 and 100%, by soya milk and lactic products. Full fat soya flour was used in quantities of 3, 5, 8, 10, 15 and 20%.

Based on test sample data, we studied the impact of the selected additives on the quality of whole wheat bread, particularly on: physical-chemical and organoleptic characteristics, accumulation of flavoring substances in a crumb and crust of bread. Then we were scoring the product. Based on the results of studies carried out, there have been specified the optimal quantity of additives.

The next stage of the study was aimed at combining food additives to determine the optimal ratios. Organoleptic evaluation of finished products was carried out by profile method. The impact of the optimal quantity of food additives on the quality of finished product is shown in Figs. 4–6. For making the bread, there have been used raw materials and ingredients as follows: wheat flour of first grade, pressed yeasts, salt, vegetable oil, soya milk or soya milk's lactic product, soya pomace, sprouted soya grain, roasted soya's full fat flour, water and condiments. During the first stage, there is preparation of raw materials – water heating, preparation of an emulsion of yeasts, making a salt solution, preparation of soya milk and pomace, producing lactic product from soya milk, soya

Fig. 1. Sprouted soya grain.

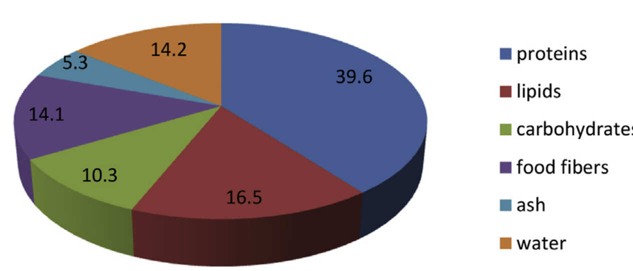

Fig. 2. Soya grain's chemical composition before sprouting.