PRODUCTION CHALLENGES OF ENRICHED FLOUR PRODUCTS

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Abstract

The basis of adjusting the quality of multicomponent dispersible food systems that include high- and low-molecular units and water is using of additives which can form structure. Understanding of the mechanism of interactions between these additives and food basic components will allow improving the quality of products and simplifying the technological process. The products are made of flour raw material which is popular enough in the whole world. However, mostly the technologies of flour based products need the involving structure forming additives. The possibility of functional animal proteins (FAP) and enzymes (transglutaminaze) application for improving dough rheological properties of the bread and cereal products is considered in the article. The goal of present scientific research is to establish the influence of protein additives on rheological properties of dough. As a major part role in flour products structure formation belongs to the proteins, first of all the influence of structure-forming additives on an amount and quality of wheat gluten was analyzed. The increase of gluten resiliency with FAP and transglutaminase (TG) on 12% and 64% respectively was established. It was also found that FAP cause a significant compaction of product structure. The increase of elasticity and plasticity of dough and reduction of resiliency and irreversible relative deformation are revealed while the research. As rheological properties determine the quality of final products, the effect of FAP and TG on the stability of breads shape and culinary properties of flour products was evaluated. It was determined that the dimensional stability of bread with FAP grows by 55%, duration of cooking flour molded products increased by 42%, and the transition of solids into the cooking environment is reduced to 97%. An improvement of the rheological and culinary properties of baking and flour molded products with using proteins additives occurs due to the formation of new connections in the protein molecules was suggested in the experimental data.

Keywords: functional animal proteins, transglutaminase, bakery products, flour molded products, rheological properties, culinary properties.

1. Introduction.

Today we can't imagine our food without bread, pasta and cereal products, because the flour based products involving various cereals are related to the most socially relevant, essential and affordable food. Therefore, they have to meet high quality requirements. Ever-increasing consumers demands to the organoleptic and physico-chemical quality charactersitics of flour products, their nutritional value and safety have necessitated the application of improvers in technological system in different areas. Considering the industrial experience, it is recommended to enter different techniques to improve the properties of grain and flour. One of the suggested techniques is to change the grain hydrothermal treatment process and forming grinding parties by means of the microwave technologies and infrared radiation, active control, extrusion, germination, using additives, vitamins, minerals etc. [1]. However, negative aspect of these technological solutions is usually due to their low efficiency and high cost of implementation.

Taking into account the promotion of healthy nutrition and wellness among the population, international manufacturers of food processing industry actively began to represent advanced technologies, involving natural supplements that improve both nutritional value and structural-mechanical properties of products. Proteins additives, in particular FAP and enzymes, deserve a special attention among all structure-forming additives.

FAP is a relatively new form of food additives commodities derived from secondary resources of meat industry. FAP mainly include the connective tissue consisting of cells, intercellular substance, collagen fibers, small amount of elastin and retikulin fibers and blood vessels.

Compared to traditional chemical improvers FAP have both sufficiently high functionality and nutritional value. Manufacturers guarantee absolute safety of additives to the human body pointing out the innovative technology with safety control standards. FAP are characterized by neutral organoleptic properties, reveal gelling ability, emulsifying capacity and thermal stability, which allows their application for improvement of textural properties of big variety of food products. FAP have recently appeared on the world market, but there is a lack of theoretical and practical experience in their utilization [2].

Many scientists found that main flour properties depend on the state of protein and carbohydrate complexes. The extent and rate of change of these complexes results in the dough and the final product quality. Hence, there is a possibility of flour baking properties regulation for the desired products quality characteristics is using enzymes - biological catalysts. Today the most prospective area is using of TG - an enzyme that has a wide application in the food industry. In nature transglutaminaze was found in most animals organisms and it is involved in various biological processes. This enzyme acts exclusively on proteins to catalize the reaction of a specific izopeptide connection between γ-karboksyamid group of glutamine and ε-amino group of lysine. These links can be formed between proteins that differ by type (casein, myosin, globulin, anemones, etc.) and origin (protein wheat gluten, soy, etc.).

Due to formation of new peptide bonds between the protein molecules TG improves the rheological properties of dough by sealing the texture of the product. Using enzyme allows enhancing the flexibility, thermal stability, density and moisture holding ability of the product [3].

Nowadays there is some experience with FAP and transglutaminaze occurred in various sectors of food industry, particularly, in the meat, confectionary and bakery production. But the limited data on the technological aspects the protein additives application in bakery products and the mechanism of their interactions with basic compounds of flour from different cereals requires additional scientific justification and generalization.

2. Methods & materials.

FAP Scanpro T95, enzyme transglutaminaze, wheat flour, bread and flour molded products were selected as objects of study.

Rheological properties of dough samples were determined using classical and modern equipment. In particular, we used modified Tolstov Elastometer test. Measurement on Elastoplastometer based on determining the shear deformation attributed to the thickness of the sample. Under the experiment, the loading/unloading curve (Fig. 1) was obtained. Number of the rheological properties of dough can be determined: relative plasticity, relative elasticity, relative resilience, irreversible deformation etc [4].

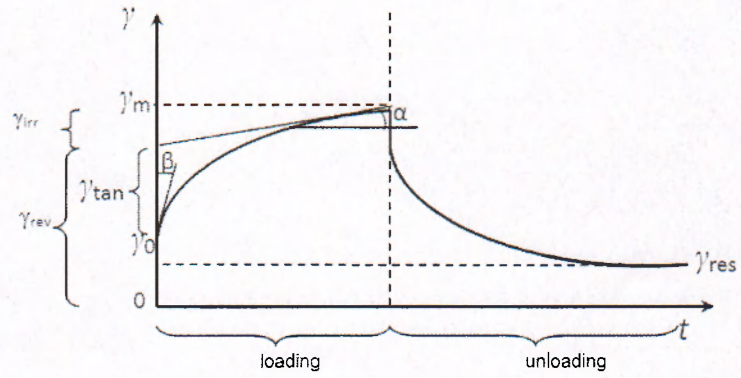

Fig. 1. Loading/unloading curve under the applied shear stress. γ – relative deformation

On the loading part of the curve we can mark three areas: the area of instantaneous resilience deformation, the area of development hyperelastic deformation and the area of systems flow that comes with fading speed. Strengthening of dough in the process of deformation does not allow to determine ε (τ) separately elasticity and residual resilience formation of currents on the loading part of the curve. So it found using the unloading part of the curves.

The effect of FAP and TG the state of flour biopolymers was determined by the quantity and quality of wheat gluten, according to the standard procedure [5].

Quality of finished products was characterized by organoleptic properties, culinary properties and shape stability test.

3. Results & discussion.

It is known that protein additives, in particular, privacy enzymes and FAP can interact with flour biopolymers. The goal of present study was to establish the influence of these additives on the quality and quantity of gluten. Wheat flour with unsatisfactory weak gluten group was selected for the experiment. The experimental data are presented in Table. 1.

Table 1

The influence of protein additives on the quantity and quality of wheat gluten

Pattern	Additive concentration, % (w/w)	Raw gluten, % (w/w)	Resilience, dev.un.	Extensibility, cm	Water absorbing capacity, %
Control	-	28,52	116	32	184,50
Scanpro T95	0,5	29,08	111	30	179,69
	1,0	29,40	109	30	170,10
	1,5	29,40	105	28	152,30
	2,0	29,44	102	27	144,24
Transglutaminaze	0,5	27,88	70	28	146,2
	1,0	27,8	63	26	135,40
	1,5	27,56	52	25	125,1
	2,0	27,28	42	23	119,2

Analysis of experimental data shows a positive effect of additives on the flour gluten. It was found that Skanpro T91 enhances raw gluten amount probably due to the ability of FAP to interact and form new molecular units with gluten. Also gluten resilience reduction was indicated. FAP in a 2% (w/w) amount causes gluten strengthening that can transfer gluten from unsatisfactory weak to satisfactory weak group. Besides, extensibility decrease at 15% also proves gluten strengthening. Water absorbing capacity is also reduced due to reducing the amount hydrophilic patches on the surface of the protein.

TG adding has more expressive character. It should be noted a sharp decline of dough resilience. Adding of TG in the amount of 0.5% (w/w) can attribute gluten to the good group and adding 2% (w/w) strengthens it to satisfactory straight group. These experimental data confirm the ability of TG to form new bonds in protein molecules. Raw gluten content is reduced proportionally adding additives that caused by decrease in the number of hydrophilic patches and sequently reduced water absorption capacity.

As TG and FAP impact the structure of the dough, the next step the experiment was to to determine the influence of additives on the dough elasticity and plastisity using Tolstov Elastometer test. As an example, the dough for flour molded products was chosen (Fig. 2).

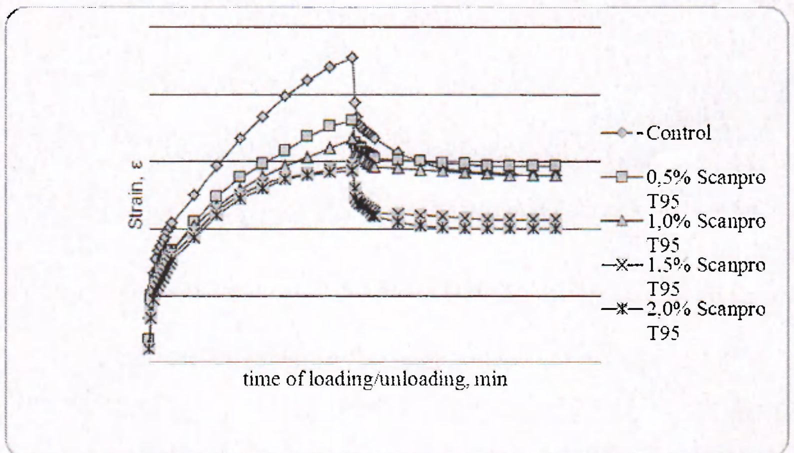

Fig. 2. Loading/unloading curves of non-yeast dough (W= 32…37%) including FAP Scanpro T95 in different concentration range