World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:7, No:7, 2013

Production of the Protein-Vitamin Complex from Wheat Germ

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Open Science Index, Agricultural and Biosystems Engineering Vol:7, No:7, 2013 publications.waset.org/16301/pdf

***Abstract*—**Wheat germ has a balanced amino acid composition of the protein, which is well digested by enzymes in the gastrointestinal tract of humans, a high content of vitamins, minerals and unsaturated acids. Introduction components grain food products will enrich their biologically important substances, giving these products a number of valuable properties and reducing their caloric. A complex natural system of substances in foods will help replenish the body's need of essential nutrients, increasing its resistance to the harmful effects of the environment, prolong life. In this regard, there was a need for the development of production technology of protein complexes from wheat germ and then applying them in food, particularly in the dairy industry. Experimental studies were conducted to determine the number of herbal supplements on the sensory characteristics of the product. Studies have been conducted to determine the optimal process parameters of water activity and moisture content of the investigational product.

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***Keywords*—**Wheat germ, sensory characteristics of the product, water activity.

I. Introduction

THE production of grain and its processing since the most ancient times took an important place in life of people. Grain is a natural source of starch, protein, vitamins, microcells and other biologically important substances necessary for growth, development and normal physiological activity of the person [1]. Of particular importance is the germ of the grain, which is rich in almost full of protein, vitamins, lipids, macro-and micronutrients.

Annually, in Kazakhstan, on average harvest of wheat around 15.0 million tones, 5 million tones of produce flour. The use of modern mill complexes makes it possible to produce wheat germ flour in the formulation of their number each year is more than 100 tons Wheat germ - is a natural blend of amino acids, vitamins B1, B2, B3, B6, B15, E, P, provitamin A, pantothenic and folic acid. Furthermore, they contain more than 20 macro-and microelements [2]. The particular advantage of wheat germ is a high content of tocopherol. The introduction of grain components in meat products will enrich their biologically important substances, giving these products a number of valuable properties and reducing their calorie content. A complex set of natural substances contained in such products will contribute to reducing the body's need for essential nutrients; increase its resistance to the harmful effects of the environment, prolongation of life.

The use of protein-vitamin complex based on vegetable raw materials in the technology of meat products - is one of the most promising directions in the development of products with a given chemical composition. The combination of ingredients of animal and plant origin in the prescription formulations leads to mutual complement and enrich the missing biologically active substances [3].

Now the wheaten germ is applied basically by manufacture of the combined forages to animals. However there are workings out on its use in the meat and dairy industry, mainly by manufacture of meat semi manufactured products, canned meat, and also sour-milk products [4].

In this connection use of secondary grain resources and working out of biologically active substances for enrichment of foodstuff was a research objective.

II. Research Results

In the course of research used the wheaten germ made at flour-grinding industrial complex.

Histologically, the embryo is divided into germ (embryonic germ and the spine of the plant) and the surrounding embryo tissue-guard. Table I shows the biochemical characteristics of wheat germ with the data on the content of some biologically important compounds.

TABLE I
Biochemical Characteristic of Wheat Germ

Components	Content		
	In the whole germ	In parts of germ	
		embryo	scutellum
Protein, %	26-40	35-44	24-32
Lipids, %	13-31	12-17	13-27
thiamine mg/100g	16-41	13-35	40-58
Riboflavinum,	9-19	8-17	12-22

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mg/100g			
Niacinum , mg/100 g	33-48	30-55	40-46

In the embryo of proteins up to 41%, the percentage of fat in the germ is very high - an average of about 15. Thus, the embryo almost 80% of proteins sugars and fats. These substances are needed as a nutrient material for the fetus.

The process of fermentation of wheat germ by a complex of proteolytic enzymes, on purpose creation of a protein-vitamin complex is investigated. In the course of fermentation technological parameters of fermentation, such as concentration, temperature and active acidity (pH) were established. Effect of enzymes depends on a number of factors, first of all on temperature and environment reaction (pH). Optimum temperature, at which activity of enzymes is highest, is in limits 35-45^{o}C.

When the temperature rises above the optimal enzyme reaction rate also decreases and finally stops completely.

The most important factor that affects the action of enzymes is the active reaction of the medium-pH. Optimum active pH of the fermentation is 5.5 to 6.0. The concentration is 67%, enzyme dosage of 0.1% by weight of the feedstock.

As a result of research it is established that optimum duration of fermentation is in limits from 1.5 to 2.0 hours.

After fermentation for enrichment of a protein complex by vitamins carrot and beet juice has been brought. Vegetables contain a few proteins and fats, but are rich vitamin and mineral substances. Experimental studies have been conducted to determine the number of herbal supplements on the sensory characteristics of the product (Table II, III, IV). Experimental studies were carried out at the following amounts insertion of herbal supplements: Experience 1 - 5%, the experience of 2 - 10%, the experience of 3 - 15%, 4-20% experience, the experience of 5 - 25%.

TABLE II
SENSORY EVALUATION OF PROTEIN COMPLEX WITH ADDITION OF CARROT JUICE

Product name	Carrot juice, %	Sensory evaluation			Total mark
		Appearance	Colour	Consistence	
Protein complex	5%	4,5	4,3	4,2	4,3
	10%	4,6	4,4	4,3	4,4
	15%	4,7	4,6	4,6	4,6
	20%	4,8	4,6	4,6	4,6
	25%	4,7	4,5	4,5	4,5

TABLE III
SENSORY EVALUATION OF PROTEIN COMPLEX WITH ADDITION OF BEET JUICE

Product name	Beet juice, %	Sensory evaluation			Total mark
		Appearance	Colour	Consistence	
Protein complex	5%	4,7	4,6	4,5	4,6
	10%	4,3	4,3	4,3	4,3
	15%	4,2	4,2	4,2	4,2
	20%	4,2	4,1	4,1	4,1
	25%	3,8	3,9	3,8	3,8

TABLE IV
SENSORY EVALUATION OF PROTEIN COMPLEX WITH ADDITION OF ONION JUICE

Product name	Onion juice, %	Sensory evaluation			Total mark
		Appearance	Colour	Consistence	
Protein complex	5%	4,4	4,4	4,5	4,4
	10%	4,5	4,6	4,6	4,6
	15%	4,5	4,5	4,5	4,5
	20%	4,2	4,2	4,3	4,2
	25%	4,1	4,0	4,0	4,0

The table shows that the highest sensory had 15-20%-s in the ratio of carrot juice, 5%-s ratio of beet juice and a 10-15% ratio of onion juice protein complex.

It is known that water activity and moisture-binding ability of foodstuff – one of the basic indicators defining such important properties, as a period of storage. In this connection researches by definition of optimum technological parameters of water activity and humidity of investigated products have been conducted.

Water activity was defined on the installation developed by academician U.Ch.Chomanov [5], based on direct change of the partial pressure of constant water steams over investigated products.

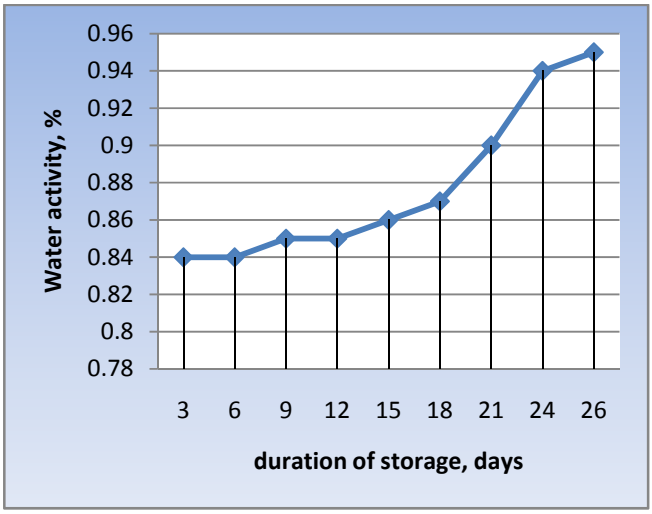


Fig. 1 Research of water activity in storage of protein-vitamin complex

Studied sensory characteristics of protein-vitamin complex in storage.

TABLE V
SENSORY EVALUATION OF PROTEIN-VITAMIN IN STORAGE

Product name	Storage, day	Sensory evaluation			Total mark
		Apperance	Colour	Consistence	
Protein complex	5	4,7	4,6	4,7	4,7
	10	4,7	4,6	4,6	4,6
	15	4,5	4,6	4,5	4,5
	20	4,5	4,5	4,4	4,5
	25	4,3	4,3	4,4	4,3

High sensory characteristics of protein-vitamin complex obtained between 5 - 10 days of storage.

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Thus, the shelf life of protein-vitamin complex is 7-10 days.

The technology of the new cooked and cooked smoked sausages made of horse meat with protein-vitamin complex.

Based on the studies recommended that the optimal ratio between the ingredients (Tables VI, VII).

TABLE VI
COOKED-SMOKED LUMPY SAUSAGES FORMULATION WITH PROTEIN-VITAMIN COMPLEX

Raw materials, g /100 kg	Cooked-smoked sausages
Horse meat I category	85,00
Protein complex	15,00
Total	100,00
Spices and spicery, g /100 kg	
Granulated sugar	100
Black pepper	100
Garlic	200
Salt	1500
Sodium nitrite	5,4
Total	2005,4

TABLE VII
THE RECIPE OF COOKED SAUSAGE WITH PROTEIN-VITAMIN COMPLEX

Raw materials, g /100 kg	cooked sausage
Horse meat I category	80,00
Protein complex	20,00
Total	100,00
Spices and spicery, g /100 kg	
Granulated sugar	100
Black pepper	100
Garlic	200
Salt	1500
Sodium nitrite	5,4
Total	2005,4

Quality indicators of amino acid, fatty acid, vitamin and mineral composition of the new cooked-smoked and cooked sausages with a protein-vitamin complex.

Studies of food and biological value of new cooked-smoked sausages and cooked horse meat have shown that they are not inferior to the control samples (Table VIII).

TABLE VIII
THE CHEMICAL COMPOSITION OF THE NEW COOKED-SMOKED AND COOKED SAUSAGES

Sausage products	Content			
	moisture	protein	fat	ash
Cooked-sausage				
Control	64,91±0,62	15,07±0,24	18,12±0,12	1,67±0,11
Test	62,34±0,73	19,4±0,33	12,9±0,23	3,11±0,12
Cooked-smoked sausage				
Control	64,75±0,64	15,72±0,25	18,14±0,17	1,39±0,13
Test	39,1±0,63	24,5±0,34	29,1±0,18	4,3±0,14

Analysis of the amino acid composition shows a rich set of essential amino acids in the proteins of prototypes of new cooked-smoked and cooked sausages. They are characterized by an increase in tryptophan, lysine, methionine, valine, leucine, phenylalanine (Table IX).

TABLE IX
THE CONTENT OF ESSENTIAL AMINO ACIDS IN THE COOKED-SMOKED COOKED SAUSAGES WITH PROTEIN-VITAMIN COMPLEX

Sausage product	Essential amino acids							
	tryptophan	lysine	methionine	threonine	valine	isoleucine	leucine	phenylalanine
Cooked-sausage								
Control	1,58	5,62	3,64	3,44	5,71	5,32	7,74	3,25
Test	2,73	16,83	4,58	8,94	9,64	7,73	14,46	8,29
Cooked-smoked sausage								
Control	1,59	5,72	3,68	3,46	5,74	5,37	7,76	3,27
Test	3,43	21,12	5,75	11,22	12,10	9,70	18,15	10,40

The biological value of a cooked-smoked and cooked sausages confirmed the content of polyunsaturated fatty acids, minerals and vitamins (Tables X, XI and XII).

TABLE X
FATTY ACID COMPOSITION OF COOKED-SMOKED AND COOKED SAUSAGES WITH PROTEIN-VITAMIN COMPLEX

Name of fatty acids	Code C_n	Cooked-smoked sausage	Cooked sausage
Saturated:		10,06	4,42
Myristic	14:0	10,18	4,43
Palmitic	16:0	7,73	3,40
stearic	18:0	1,30	5,47
Monounsaturated:		14,00	6,16
myristoleic	14:0	2,23	0,98
palmitoleic	16:0	2,58	1,13
oleic	18:0	11,20	4,93
polyunsaturated:		4,10	1,80
linoleic	18:0	3,46	1,52
linolenic	18:0	6,35	2,79
Total amount of fatty acids:		28,16	12,39

TABLE XI
MINERAL COMPOSITION IN COOKED-SMOKED AND COOKED SAUSAGES WITH PROTEIN-VITAMIN COMPLEX

Sausage product	Mineral composition, mg/100g					Energy value
	Mn, mcg	Zn, mcg	Mg	P	Fe, mcg	Kcal
Cooked-smoked sausage	487	3309	41	228	3376	203
Cooked sausage	478	3259	35	202	3324	371

TABLE XII
VITAMIN COMPOSITION IN COOKED-SMOKED AND COOKED SAUSAGES WITH PROTEIN-VITAMIN COMPLEX

Sausage product	Vitamins, mg/100g						
	A	β-carotene	E	C	PP (niacin)	B_2 (riboflavin)	B_1 (thiamine)
Cooked-smoked sausage	1,04	262	1,53	0,5	3,08	0,15	0,13
Cooked sausage	0,97	249	1,38	0,8	2,90	0,11	0,09

The concept of biological value of the product involves not only the content of protein, fat, minerals, vitamins, but also the qualitative characteristics of the individual components, the content of proteins in the individual amino acids, fatty acids, polyunsaturated fats.

III. Conclusion

Based on these results we can conclude that the wheat germ possessing good functional technological and biological properties, can be used for production of meat products. The use of protein-vitamin complex can enrich preparations ballast carbohydrates, water-soluble vitamins, minerals and other biologically active substances.

As a result of the study was develop recommendations on the use of protein-vitamin complex to improve the functional orientation of food and the resulting innovative patent number RK 26209 "Method for the production of sausages with the use of protein-vitamin complex."

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