Akaki Tsereteli State University
Faculty of Engineering and Technology

Khatia Khvadagiani

Processing of floury product technologies with high biological cost by using vegetable raw materials enriched with protein

Presented for awarding an academic doctoral degree in food technologies
(0104)

Thesis Herald

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The dissertation work is performed in the Food Technology Department of the faculty of Engineering and Technology of Akaki Tsereteli State University.

Scientific Adviser: **Maria Silagadze,** Doctor of Science of Technics, Professor, Academician of Georgian Engineering Academy

Reviewer: **Temur Revishvili** Chief Scientist, Doctor of Technical Sciences, Professor.
Ketevan Kintsurashvili Doctor of Technical Sciences, Professor of National Academy of Sciences.

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General Description of the thesis

Topic actuality

Modern lifestyle, different ecological situations, products of high technological (refined and long-term preservation) stipulated deficit of valuable albumen and micronutrients in food products which according to specialists compose 30% of products consumption.

Nutrition structure is far from the scientific argumentation. Particularly, there is a lack of albumens, food fibbers, prebiotics, polyunsaturated fatty acids, phospholipids, calcium, magnum, B, A, D, E vitamins and level of their consumption is much less then recommended rational standards. This is why during past years a big attention is paid to socalled functional foods which actually represent physiologically active set of mixtures of vegetable origin.

Flour products especially bakery products are the main products in human's food ration and it is very actual to ensure the balance of its composition, especially according to contain of albumen. Therefore,it is a very important social issue to develop such technological processes which enhance the biological cost of flour products by ensuring the long-term preservation. Modern scientific achievements in the field of making enriched food products increased the possibility of using traditional ingredients in food technologies. From above mentioned positions the issue of rational consumption of soya and nuts is notably interesting in bread production with high contain of albumen. A special attention is paid to utilization of regional resources (also not traditional ones). After considering the elementary factors it is much perspective and actual to find the raw materials of low calories and low glycemic and to conduct the complex research with the perspective of using them in functional food production. It is possible to use products of soya and nuts processingin the form of food appendages and their functional action are stipulated by their unique chemical composition. It is important that soya products as the source of valuable albumen areused in different fields of food industry. It is ascertained that soya albumen helps to reduce cholestenone, to normalize pressure; it is also named after preventive product for cardiovascular diseases. Soya products have a good ability of absorption, low price that makes it attractive for the undertakers. The influence of soya flour on the quality of food products is studied by different scientists – I.

Kostrova, I. Gaponova, L. Zabodalova, L. Naltoch, T. Arsenieva and etc. The research materials about the influence of soya milk and lactic acid, also products of nuts utilization on the quality of wheaten bread cannot be found in literature. Also the possibility of using products after nuts utilization in the production of wheaten bread is not studied. Therefore, research dedicated to increasing the nutrition value of bakery products by complex use of soya and nuts utilization products is timely and actual and has a social-economic meaning.

Main goals and objectives of research

Goals of research are to develop innovative technologies of new generation dietary bakery products enriched with high biological cost, low calorie, low glycemic and vegetable albumen on the basis of complex research of native raw materials.

According to the above mentioned goal it was necessary to fulfil the following objectives:

- To review and analyze the literature, to formulate main direction of scientific research;
- Argumentation of choosing native vegetable raw material enriched with albumen, with low calorie and low glycemic;
- Study of chemical composition of selected raw material
- Biochemical research of selected raw material
- To process technologies of different functional food appendages enriched with albumen from chosen raw materials and to analyze their composition
- To analyze the dynamics of changes of main technological parameters in the boiling process of flour semi-products under the influence of obtained appendages;
- To analyze the physic – chemical, structural – mechanical and organoleptic indexes of ready products under the influence of obtained appendages;
- To develop original, innovative technology by using processed functional appendages;
- To determine calories and nutrition value of ready products;
- Production approbation of research products;

Scientific innovation of the thesis is that it is the first time when different species of soya spread in western Georgia and functional

appendages produced on their basis is studied by us in perspective of using them in dietary bakery production. On the basis of complex research of above mentioned appendages the new, scientifically grounded assortment of dietary bread and original technology of its production is processed and offered by us.

- Optimal quantities of processed functional ingredients are ascertained;
- It is also ascertained that they accelerate boiling activation of yeast which ensures optimization of semi-products boiling processes and reduces duration of delay
- It is also ascertained that their utilization increases microbiological stabilization, stops potatoes disease and increases the duration to keep fresh ready products longer than before.

Practical importance of the work:

- Technological parameters for producing functional appendages of soya are developed;
- It is ascertained that functional appendages which contain albumen improve the organoleptic, physic-chemical and structural-mechanical properties of wheaten bread and increase the duration of preservation.
- On the basis of research results, new bread assortment is developed by using albumen appendages with appropriate technical documentation.
- Production Approbation of processed technologies is already conducted in Akaki Tsereteli State University experimental mini-bakery and ltd. "Alta" (Kutaisi).

Scientific provisions for the presentation:

- Argumentation for choosing native, vegetable raw materials enriched with albumen for producing bread with high biological value.
- Results of the analyzing process of chemical composition and biochemical parameters of chosen raw materials.
- Technologies to prepare functional appendages from chosen raw materials.
- Results of the analyzing process of physic – chemical, structural – mechanical and technological parameters of bread semi-products under the influence of functional appendages.
- Final results of flour appendages influence on the quality of bread.

Work approbation

Separate results of dissertation thesis are periodically presented at the meetings organized by of Akaki Tsereteli State University, Department of the Food Products technologies (2013 – 2016). Thesis results are discussed and published in following materials of international scientific and practical conferences:

- International scientific-practical conference "Innovative technologies and modern materials", Kutaisi, Akaki Tsereteli State University, 2013;
- International scientific-practical conference "Science and innovative technologies", Kutaisi, Akaki Tsereteli State University, 2014;
- International scientific- practical conference "Moderns engineering technologies and environment protection", Kutaisi, Akaki Tsereteli State University, 16

Publications

6 scientific articles are published on the subject of dissertation in Georgian and foreign periodical publications with high ratings.

Structure and Volume of the thesis

Dissertation thesis is represented by 120 pages printed on computer and contains 5 chapters, main conclusions and 107 literature sources, 21 timetables, 7 pictures and 16 draughts.

General contents of the thesis

Dissertation thesis contains introduction, 5 chapters, main conclusions and used references.

Introduction is about topic actuality, goals and objectives, scientific innovation and practical value.

First chapter – Literature review – technologies of producing wheaten bread are discussed. Also advantages and disadvantages of different technological methods are analyzed; biochemical mechanisms of different processes and theoretical basis of fermentation process of semi-products are discussed. It is presented that main property of new technological schemes in wheaten bread production is reducing the whole production cycle on the expense of technological processesintensification. The methods of increasing biological value of wheaten bread by using traditional or nontraditional raw materials are also discussed. Perspectives of using leguminous and soya products in flour productsproduction are examined; there is data on the possibilities of improving food production technologies by using sprouted wheat and it's role is analyzed in moderns' life.

Second Chapter – Thesis objects and methods are discussed

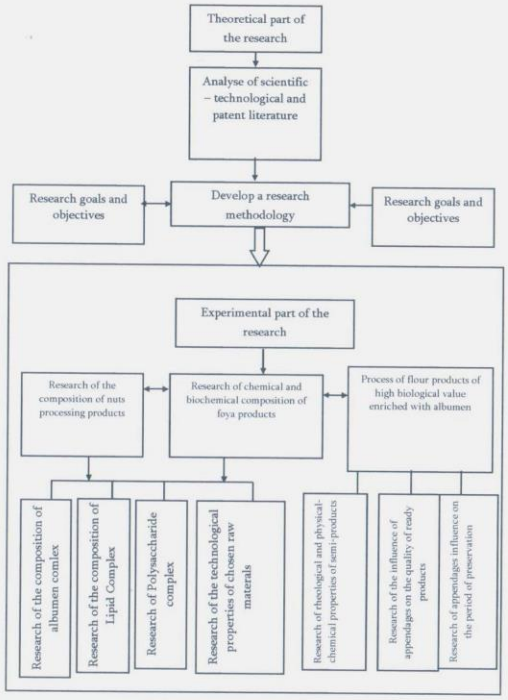
Objects are products of nuts processing – flour of nut oiscake and flour of nutshell; examples of soya grain obtained in peasant farms from different regions of Georgia in 2014-2015: more specifically, from Tskaltubo – soya from Imereti, from Samtredia – soya from Imereti, from Lanchkhuti – soya from Guria and soya from Chiatura. Also, there were other objects of thesis: sprouted soya grain, soya milk, soya secretion and dietary bread.

For determination of the quality of raw materials, semi-products and ready products we used not only generally accepted, standardized but also special methods and instruments which are also used for technological control of bread production.

Research Strategy is represented on structural scheme (draught 1.)

Chapter3. Obtaining nuts processing products and its analyze.

Considering natural resources of Georgia, according to our goals, we paid attention to soya – leguminous enriched with albumen and secondary product of nut fruit – nut oiscake which is left after obtaining oil from nut fruit.



Draught1. Structure of research

Common chemical composition of nutoiscakeand nutshell flour, biochemical and technological properties are studied. Connection between these properties is discovered on biochemical, physical-chemical and structural-mechanical properties of bread and dough by using different dozes of these appendages. The methods and parameters how to manage the technological process are established. Chemical composition of appendages is compared with traditional raw material of bread baking – first degree wheat flour. Study results are represented in timetable N1. Based on the study results, it is ascertained that most part of the chemical composition of nutshell flour is food fibber (51.3%); lipids (13.2%) and albumen (12.3%). Dissoluble albumens are dominants in factional composition of albumen substances – albumens and globulins (52, 2% in the whole quantity of albumen). Analyze process of nut oiscakereleased that albumen substances (35,4) and lipids (24.9%) predominate in its composition, part of carbohydrates is 29.9 % and 16.1 is food fibbers.

there is represented structural-mechanical propertiesresearch results of mixture of the first degree wheat flour with nut processing products.

Chemical composition of wheat flour, nutshell and nut kopton flour, %

Timetable 1

Chemical composition	First degree wheat flour (control)	Nuthsell flour	Nut kopton flour
water	12,70	9,20	2,65
carbohydrates	74,16	58,20	29,90
Including starch	66,05	6,80	12,40
Derogatory sugars	1,40	0,08	1,19
Sucrose	0,16	–	0,22
Pentosans	3,98	–	–
Food fibbers	0,57	51,30	16,10
albumens (Nx5,7)	11,26	12,30	35,40
General nitrogen (N)	1,97	2,16	6,21
fat	1,02	13,20	24,90
ashes	0,76	5,10	4,70

During technological process, technological properties like gas production, autolyze activation are very important as it reflects on rheological properties of dough. These are: dough's abilities to absorb water, time for dough formation, stability, quality of becoming lequid and resilience. One of

the properties of bread baking is flour's ability to provide dough with some structural-mechanical properties. In the timetable 2

Nutshel and nut oiscake flour influence on the rheological properties of dough made by first degree flour

Timetabel 2

Rheological properties	control	appendages, % proportioned with flour weight											
		Nutshell flour						Nut oiscake flour					
		1	3	5	8	10	15	1	3	5	8	10	15
Ability of water absorbtion, ml/100g on flour	69,8	70,0	72,2	71,9	71,6	66,4	59,0	69,8	71,0	71,8	72,0	69,0	67,2
Ability to form a dough	3,2	3,2	3,2	3,4	3,5	4,0	5,6	3,0	3,2	3,6	4,0	4,0	4,2
Dough stability	5,0	5,0	5,0	5,5	5,5	4,5	3,0	5,0	5,0	5,5	6,0	6,5	6,5
Unit of quality of dough's ability to become liquid, unit for instrument	40	40	30	30	30	30	20	40	40	40	30	30	30
Dough resilience Unit for instrument	130	130	130	140	40	160	160	130	140	140	150	150	170

After results analise it is clear, that according to rheological propertiesmost effective is nutshell flour apendage 3-5% and appendage of nut oiscake flour 5-8% ratio to the weight of wheat flour. A positive influence of optimal dozes of research functional appendages is ascertained according to the results of gluten dissolubility research in the process of dough kneading (draught 3 and 4), which is in our opinion stipulated with the lipid-albumen interaction of appendages with dough components.

By the method of extraction from the examples of nutshell flour and nut oiscake lipids were obtained and the research of their fractal and fat acid composition was conducted. Results revealed that the main fraction of lipids are triglycerides and disposable fat acids.

Nut processing products influence on the quality of wheat bread

The series of experimental baking process was conducted to ascertain the influence of nut processing products on the quality of first degree bread. Appendages were added during the dough kneading process. The results of above mentioned experiments are represented in timetables 3 and 4.

By using these appendages the new bread assortment was processed

named after "Imeruli". Recipes and technologies are mentioned in chapter 5.

Influence of nutshell flour on the quality of wheat bread

Timetable 3

bread quality properties	control	By adding nutshell flour %			
		1	3	5	10
Humidity of bread core %	43,0	43,0	43,2	43,5	43,8
Acid, degree	**3,5**	**3,5**	**3,6**	**3,8**	**4,0**
Porosity, %	68	68	72	74	70
Specific volume$cm^3/100_g$	3,10	3,10	3,44	3,70	3,20
Rate	78	79	82	84	75
Bread core color	Light color With yellow shade		Darker		dark
Bread core condition	Elastic				Less elastic
Bread crust condition	Bread surface is straight, without cracks and split. Crust is brown, sparkling				

Influence of nut oiscake on the bread quality

Timetable 4

Properties of bread quality	Control	By adding flour of nut oiscake, %				Nutshell flour–5%+nut oisake flour -5%
		5	8	10	15	
Humidity of bread core %	43,0	43,5	43,8	44,0	44,6	43,5
Acid, degree	3,5	3,6	3,8	4,0	4,6	3,8
porosity, %	68	74	76	78	65	76
Specific volume,$cm^3/100_g$	3,10	3,75	3,78	3,84	2,85	3,84
Rate	78	84	86	86	76	88
Bread core colour	Light colour with yellow shade	Light colour With yellow gray shade		darker	dark	darker
Bread core condition	elastic			Less elastic		elastic
Bread crust condition	Bread surface is straight (smooth), without cracks and split. Crust is brown, sparkling					

Chapter4. Products of soya processing, their analyses and influence on the quality of wheat bread

4.1 Research of biochemical and chemical composition of soya grain

It is significant that Soya is a leader of vegetable albumen production. The most important species in Georgia are from Imereti, Guria, Chiatura, advanced – 7, kokhida – 4, early – 6, from Senaki, from Imereti – cicer, from Racha – mourning bean, soya from Achara. For the goals of research, we chose soya from Imereti cultivated in the region of Tskaltubo. From the region of Lanchkhuti – soya from Guria and Chiatura.Those raw materials are from the harvest in 2014-2015 and is cultivated in peasant hosehold.

We studied chemical composition of soya grain and its biochemical properties. Chemical composition of native (Georgian) soya is mentioned in timetable 5.

After analyses of final results we can conclude that the most special according to all parameters is soya from the region of Lanchkhuti, Guria with the contain og 39.6% albumen, high contain of fat – 16.5%. Contain of hydrocarbons is lower than other species. Also the chemical composition of experimental samples do not differ from each other considerably and they can be used in a form of albumen appendages in bread production.

Research of soya micronutrient contain confirmed its high biological value.

On the next stage of research we studied biochemical properties of soya grain. Specifically, amino acid contain of soya albumen fractions.

Chemical compsition of soya from different regions (, 100 gproduct).

timetable 5

indicators	Samples of soya grain			
	Imereti (From the region of Tskaltubo)	Imereti (from Samtredia)	Guria (from Lanchkhuti)	From Chiatura
Albumens g.	33,6	34,5	39,6	32,2
Fats, g.	16,3	17,8	16,5	15,5
Hydrocarbons	17,8	14,3	10,3	20,3
Food fibber, g.	14,0	14,4	14,1	13,8
Ashes, g.	4,8	5,1	5,3	4,2
Water, g.	13,1	13,9	14,2	14,0
calories	352,3	355,4	348,1	349,5

It is ascertained that 18 amino acids are identified in soya albumen fractions and all of them are irreplaceable. Also gluten acid (16.80%) is dominant in albumen fraction, glycan (6,10%), isoleucine (10.30%), leucine (8,20%), lysine (6.80%), asparagine acid (7.30%). Sum of the irreplaceable amino acids in albumen fraction represents 45,38% of total quantity.

Glutelin acid is dominant in glubolin acid (23,30%), leucine (11,30%), arginine (6,20%), threonine (6,05%). Sum of the irreplaceable amino acids is 36,1% in above mentioned fraction.

Glutelin fraction is represented with 9 amino acids and only three of them are irreplaceable. Including Lysine (5,40%), threonine (6,60%) and leucine (27.10%) and their sum is 40% of total amino acids. Prolamin fraction in soya albumen is identified in a form of trace.

A final result about amino acid composition of Georgian soya albumen fractions are close to the data existed in literature and is much more valuable from the side of irreplaceable amino acids. On the basis of final results we can suppose that by using soya in a rational way it is possible to increase the biological value of bakery products on the expenses of supplement with food elements and especially with albumens.

Obtain and research of products after processing of soya grain

While obtaining raw materials of high bio access and food value we manage with the circumstances that those raw materials must contain big amount of albumen and food fibber and also less amount of fat as the long-term preservation must be achieved by using them. That's why we preferred to use soya grain pressed or in a form of soya milk or in a form of vegetated grain. Those researches were conducted in 2 stages; 1 – to obtain products after soya processing and their research; 2 – process research of sprouting soya grain.

Before using soya grain processed products as the food appendages they were obtained in laboratory. Those products are – soya flour, soya milk and pressed soya.

Soya milk and pressed soya ("Okra") was made in the following way: cleared and washed soya grain was placed in glass vessel for retting. Water temperature is 20-25^{0}C and period of time from 6 to 12 hours. To get rid of

specific taste, water is changed for 3-4 times during the retting process. Proportion between grain and water is 1:3. In the end grain increases in size for 2-2.5 times and its cover is moved off which comes to surface and can be moved by washing. Then we put soya grain in blender, add water proportion to 1:2 and add some more water in the process of blending. During this process 5-6 times more amount of water is necessary then the weight of soya.

The final gruel mass was placed in pot and put on the furnace for boiling. Boiling process continues at a low temperature for about 15-20 minutes. After boiling soya milk is cooled to 50-60^{0}C and milk and thick sediments were separated from each other. For this it was filtered by sieve which is covered with cheesecloth. After finishing the procedure we had 2 products: pressed soya so called Okra (see picture 1.) and soya milk. Using this method we obtained 3 liter milk from one kilogram soya and 1,650 kg pressed soya. 5 liter water was spent for 1kg soya. The sequence of above mentioned process is reflected on the picture, time period for products preservation is not more than 3 days under the 1-2^{0}C temperature.

For making soya flour, grains must be washed, dried, processed in closed vessel overheated with steam during 12-15 minutes then it is dried and grinded on the laboratory mill. Soya flour cannot be preserved for a long period of time. The term of preservation is about 2 weeks and then it becomes tart. So it is more accepted to preserve soya grain and not the products of its processing. Soya flour is better preserved after thermal (fry) process. Fried soya flour can be used as aroma appendages in bakery production. Fried flour is light brown, with specific nice smell and aroma like fried nut. It can be preserved longer, for about 2 months under 20÷25^{0}C temperature.

Soya milk is white colored drink; it is a stable emulsion containing fat, water and albumen. It is rich with albumen and cells and does not contain sugar lactose and is product with low calorie. Soya milk contains big amount of B group vitamins.

Chemical composition of products – soya flour, Okra and soya milk is studied. Total amount of albumen, fats, carbohydrates, food fibbers, ashes and water is determined in these products.

Pic. 1 Soya milk and pressed soya ("okra")

Chemical composition of products after soya processing (100g products)

Tmetable 6

Name of mixtures	flour, %			
	Soya grain	Soya flour with fat	Soya milk	Pressed soya „Okra"
albumens	33,6	35,2	3,1	3,7
fats	16,3	17,8	1,9	1,9
carbohydrates	17,8	28,4	3,0	11,8
water	13,1	10,2	90,3	77,9
Food fibbers	14,0	3,1	0,7	3,8
ashes	4,8	4,2	0,6	0,8
Energetic cost	352,3	414,6	41,9	79,1

4.3 Substantiation for methods and regimes of soya grain ferment modification

For obtaining products of high biological value with balanced ingredients we conducted soya grain modification. With this purpose we used one of the most perspective and safe methods, method of fermented modification based on the activation of grain's endo fermented system which happens during the grain sprouting process in damp area. In this experiment we used soya grain of 2015 harvest from four different regions of Georgia. Sample 1 – from Tskaltubo; Sample 2- from Samtredia; Sample 3 – from Lanchkhuti and sample 4 – from chiatura. Wheat grain was chosen as a control sample.

In the beginning of research we sprouted the grain and for this purpose

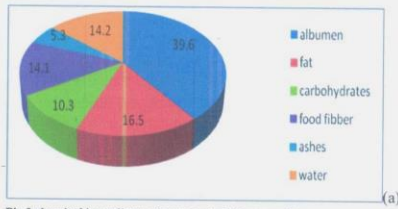
we selected grain, cleared from unknown admixtures and from damaged grains. Then kept in the water and cleared from "dead" grains – those which floated on the surface. Then washed them for several times and processed them with weak solution of potassium permanganate. Then washed them again with clean water and only after this retted it. Wigmore's modified method was used in working process. According to this method grain was placed in glass vessel for retting. The process continued for 6 hours. Then we poured out water from glass vessel, washed the grain and put cheesecloth on it and placed askew, 45^0corners so that water could easily descent from the top of glass vessel. Observations continued during several days and nights and during each of them grain was washed for 2-3 times.

Following parameters were determined – total amount of water, albumen, fats, carbohydrates (pic 2 a,b). For the estimation of biological value contain of vitamins, macro and micro elements were also determined (data of timetable 7).

Observation to the length changes of sprout revealed optimal terms of grain sprouting: 48-60 hours for wheat, 60-72 hours for soya. According to the recommendation existing in literature, sprout length of grain used for nutrition should not be more than 2-5 mm.

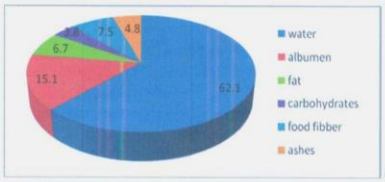
Pic. 3 describes 5 days of the grain – dynamic of sprout length changes during night time. Monitoring was conducted in every 12 hours.

Energetic cost of soya grain after sprouting process was 135.9 kcal.



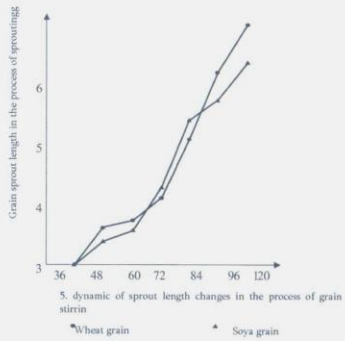
(a)

Pic.2 chemical ingredients of soya grain befor sprouting process



(b)

pic. 3.chemical ingredients of soya grain before sprouting process



5. dynamic of sprout length changes in the process of grain stirrin

Influence of different factors (temperature, length of retting process, hydro module – proportion of grain and water during retting process, amount of pouring over) on sprouting process of soya grain. In the vegetation period we determined grain vegetation quality and sprouting energy. Quality is determined with the ratio of sprouted grain to their first quantity (%). Sprouting energy is – speed of sprouting, expressed in % to the grain quantity

which had a sprout in the period of time defined by experiments from 3 to 15 days period. It is already ascertained that soya grain vegetation quality is 85%.

Ingredients of vitamins, macro and micro elements in Sprouted soya grain

timetable 7

Components	Soya grain	
	Before sprouting process	After sprouting process
Vitamins mg. %		
B1(thiamine)	0,98	2,28
B2 (Riboflavin)	0,30	1,84
B5 (pantothenic acid)	1,74	1,96
B6 (piridoxin)	0,98	1,34
B9 (Folic Acid)mkg	210	567
Vitamin C	-	22,9
Vitamin E	2,1	8,3
Microelements,mg %		
Calcium	348	
Magnium	246	
Sodium	8	11
Potassium	1680	2537
phosphorus	622	971
Microelements, mg %		
iron	11,2	25,3
Zinc	2,2	4,0
Copper mgk.	480	590
Manganese	2,6	5,18

Pic 2. Sprouted wheat grain

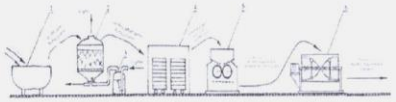
pic.3 Sprouted soya grain

The experiment revealed some optimal regimes: temperature 25 - 30^{0}C but temperature increase to 40^{0}C did not influence sprouting process. Optimal hydro module included 1 portion grain 2-2.5 water; amount of pouring over

3-4 times during 24 hours; duration of retting was 6 hours (with several wash)

As it is already well known grain contains an important quantity of"building material" for future vegetable. There are starch, albumens, fats and etc. Nutrition substances which are "sleeping" in dry grain move to more active form in the process of sprouting – starch transform in sugar and dextrins, fats – in fat acids, albumen – into the pepdids and amino acids. The same process is in human organism during food products processing. It's concluded that most part of work is done in sprouted grain. Moreover, useful admixtures, vitamins are synthesized. In a process of sprouting grain rudiment gets micro elements and other mineral substances from water that are used for vegetation. Mineral substances are in their natural form inside the sprout, connected to amino acids and that is why they are well obtained by human organism. Research of micro nutrient composition revealed that during the soya grain sprouting process vitamin C is synthesized which is not fixed in first grain, also quantity of micro and macro elements increased for several times (timetable 7).

Technological scheme of the production process of raw materials with high bio access is represented on the draught 4.



Draught 4.Technological scheme of the production process of raw materials (sprouted grain) with high bio access is represented on the draught

Draught 17. Technological scheme of the production process of raw materials with high bio access is represented on the draught. Grain is placed in bunker (1) and water is added. In this above mentioned bunker grain is swelled during 6 hours on the 18^{0}C temperature. Then moistened grain is placed in bunker (2) where sprouting process continues during 48-60 hours. During this process air is provided inside the bunker from the installation 3. Temperature is 18 degree during sprouting process. After sprouting process grain is dried in drying cell (4) on the temperature of 60^{0}Ctill the humidity of13-14%. After all grain is provided for the mill (5).

Chapter5. Processing of dietary bread of high biological value enriched with albumen

The final goal of our work was to develop scientifically grounded recipe and technologies of bakery products enriched with albumen by complex use of ingredients with high bio access. On the basis of conducted experiment we chose and offered secondary products of nut and soya processing p nut oiscake flour, nutshell flour, soya milk, pressed soya, also functional appendages of high biological value – vegetated soya grain.

During the process of experiment we chose optimal proportion of mentioned ingredients. Also the research of quality index of ready products confirmed that selected dozes are optimal. Considering specific taste and aroma of bread products made with soya products use of soya flour with fat is offered after its thermal (frying) process which gives an original aroma of fried nuts with other functional ingredients to ready products. In spite of the fact that proportion of wheat flour and amount of gluten is reduced because of used food appendages and which participates in forming process of framework and porous structure in semi products, ingredients used by us with strong abilities to form and catch foam and water ensures to get products of high quality and to maintain them in a fresh way for a long period of time. We suppose that this is stipulated from swelling process of dispersal phase and structure formation of albumen – polysaccharide complex. On the other side interaction of albumen and fat ensures formation of lipid-albumen complexes that influence on technological properties in a positive way.

On the basis of many experiments new assortment recipes (timetable 8 and 9) and their production technologies are processed. Prophylograms of bread organoleptic indicators are represented on the draught 5 and 6.

Recipe. Bread "Imeruli", by first degree wheat flour, form, weight).5kg.

Timetable 8

Designation of raw material	Quantity of raw material, kg (on 100kgflour)
First degree wheat flour	100,0
Pressed yeast	2,0
salt	1,5
Nut oiscake flour	8,0
Nutshell flour	4,0
Vegetable oil	2,0
total	117,5

Recipe.Dietary bread with trademark designation "bread for our existence" from first degree wheat flour, bottom and shape, weight 0,4kg.

timetable 9.

Designation Raw materials	Quantity of raw materials, kg (100ვ ბ flour)
First degree wheat flour	100,0
Pressed yeast	0,5
salt	1,5
Soya milk(or soya Lactic acid product)	30
Pressed soya	16,5
Vegetated soya grain	3,0
Friedsoyaflourwithfat	3,0
Vegetable oil	2,0
spices (Coriandri, Anise or Carum)	0,2
total	141,7

Bread "Imeruli" baking technology

Bread "Imeruli" is made by adding different kind of ingredients to the first degree flour. They are: yeast, salt, products of nut processing – nut oiscake flour and nutshell flour. In the beginning all raw materials and food appendages are prepared. Oiscake left after nut oil processing is dried inside the infrared emanation apparatus and is grinded on micro mill. Obtained flour is bolted and sent to stock bunker.

- Nutshell is dried and smashed on the rolls mill, is grinded and bolted after its cleaning and disinfection process.

Dough preparation process is carried out according to the method when all the ingredients prepared beforehand are placed together in the dough mixer. Recipe also includes adding sprouted grain. Loading of raw materials happens with the following sequence: first of all functional appendages are loaded – products of nut processing, soya grain, yeast emulsion and enough water necessary for preparing dough and all this mixture is mixed in the mixer during 3-5 minutes. Afterwards brine, vegetable oil and flour are also loaded. Dough kneading continues during 15-20 minutes. Kneaded dough is kept for 2-2,5 hours. Process of fermentation is considered after 1 hour from one kneading. Dough expanded on rise after molding is kept in keeping cupboard on the temperature 38 – 40 ^{0} C during 45-60 minutes. After this

bread baking process continues first on 100 – 120 ^{0} C temperature during 5-6 minutes with strong steaming and then it continues during 20-30 minutes on the temperature of 210 – 220^{0} C. After bread is baked it becomes cooler and then packed in polyethylene material.

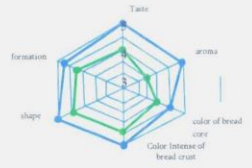
Baking technology of dietary bread named after "bread for our existence"

Following raw materials and functional ingredients are used for baking: first degree flour, pressed yeast, salt, vegetable oil, soya milk or soya lactic acid product, pressed soya, sprouted grain of soya, flour with fat of fried soya, water, spices. First raw materials are prepared – water is warmed, yeast emulsion, brine, soya milk and pressed soya is prepared. Also lactic acid product is made from soya milk, soya flour is fried (processing with infrared rays), sprouting of soya grain.

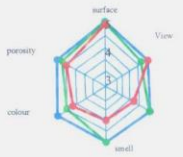
- After selecting soya grain and washing them for several time it is kept with water for 6-8 hours for swelling. Then it is washed, mixed with water and whisks well in the emulator. Afterwards water is again added and thermal treatment continues during 15-20 minutes. The final step is to separate the obtained mass on the bolter and 2 fraction are received after this – soya milk and pressed soya.
- From soya milk and sour cream lactic acid product is prepared;
- After retting and vegetation process of soya grain sprouted soya grain is made. After it is dried and grinded we get vegetated soya powder.
- For preparing soya flour with fat grain is fried on 170^{0}C during 7-10 minutes. After cooling process it is grinded and bolted.

There are two phases of dough kneading – afar and dough. First afar is prepared. It means that yeast emulsion, soya milk or lactic acid product is loaded into the emulator where they are mixed during 5-8 minutes. In this process flour is added with portions, partially. At the end mass full with oxygen is detained for fermentation. This process continues during 90-120 minutes. After this, brine, pressed soya, vegetable oil and the rest of the flour is added and dough kneading continues on a low speed. Process continues during 15-20 minutes. After it is over dough expanding on rise continues till accumulation of acid 3,5 – 4,5 ^{0}N. Then dough is molded (cutting, balling), dough is kept and finally baked. Baking process continues in convection oven

in the area of steam at the beginning and then on the temperature of 220 – 230 ^{0}C during 35-45 minutes. After cooling process bread (with the form of bread stick) is packed into the polyethylene material.



drought. 5. Prophylogram of bread organoleptic indicators
□-control
□-"bread for our existence"



drought.7.Prophylogram of bread organoleptic indicators
□-control
□- bread "Imeruli"

Main conclusions

Complex researches are conducted and on the results of these experiments the advisability of using soya processing products in the production of bakery products with high biological cost is scientifically reasonable and tentatively ascertained.

13. Based on the final results there are some conclusions: Results of the research of chemical ingredients of nut oiscake and nutshell flour, their biochemical and technological properties shows that nut processing products have high nutritional cost.
14. Research of the rheological properties of wheat bread semi products and quality of ready products shows that optimal dozes for these appendages are ascertained : for nut oiscake flour it is 3-5% and for nutshell flour – 5-8 % ratio to the weight of wheat flour. Positive influence of these appendages is ascertained by the results of the research about gluten solubility in dough kneading process which is connected to lipid-albumen interaction with dough component.
15. It is ascertained that dominants of the fatty acid ingredients of lipids

extragrated from nut oiscakean nutshell flour are acids of monogear olein and poligear linoleic indicating to the high nutritional cost of fats.

16. On the basis of rust and hydrolyze process dynamics research, in preservation process of functional appendages developed by us, optimal terms of their preservation are ascertained: for nut oiscake flour – until 6 months and for nutshell flour – not more than 3 months.
17. A positive influence of nut processing products on the quality of bread is ascertained: aroma properties are improved; production with addition of nut oiscake flour is more prior. High contain of food fibbers soluble in the water ensures to slow down the process to become bread out of date.
18. On the chemical and micronutrient research of Georgian species of soya from different regions it is ascertained that soya from Guria (Lanchkhuti) has the highest contain of albumen (39,6%). It has also high contain of fat (16,5%) and quantity of food fibers (14,1%) ensuring their high functional properties.
19. In the albumen fractions of Georgian soya there are identified 18 amino acids. In the albumen fraction sum of irreplaceable amino acids is 45,38% from total amount of amino acids. In globulin fraction – 36,1%, in gluten fraction there are only three irreaplaceble amino acids, 40% of total amount. Polyamine fraction was identifies in a form of trace in soya albumen. Soya albumens are quite enough valuable according the ingredients of irreplaceable amino acids indicating to their high biological cost
20. For increasing bio access of soya grain it's processing products are obtained – soya milk, soya flour, pressed soya and soya lactic acid produc which are used as food appendages in wheat bread production.
21. As the research result of soya grain fermental modification – sprout process the optimal technological parameters are ascertained which also ensures maximum accumulation of micro nutrients.
22. Influence of developed food appendages on the fermentation process of wheat bread semi products is developed, more precisely on the accumulation of acidity, abilities to form and catch gas, on the rheological properties of wheat bread gluten and also on the bread quality and duration of preservation. Optimal parameters are established.
23. New assortments of dietary bread with high nutritional cost and albumen are developed – "Imeruli" and "bread for our existence"; original

technologies for baking process which also ensures high tasty properties and quality with a long-term preservation. Scientifically grounded proportion of selected natural ingredients with high bio access ensures making dietary products of new generation.

24. Nutritional and energetic cost of new production is calculated. It is established that developed assortment has less calories and is less glycemic than wheat bread. Also it contains valuable albumen complex, is characterized with high bio access and with ingredients of valuable amino acids, fat acids, carbohydrates and micronutrient which ensures product's ability of good assimilation. High-tech of new assortment is ascertained by manufacturing approbation

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