GERODIETIC MEAT PRODUCTS TECHNOLOGY ENRICHED WITH CALCIUM AND PHOSPHORUS

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Received 22 June 2011, accepted 25 August 2011

Abstract: *The latest designs of national and foreign gerodietic products were analyzed. Developed a technology of sausage products with bone paste. Examined a microstructure of model sausage meat with different content of bone paste. Determined the optimal share of bone paste in sausages.*

Keywords: *meat, bone paste, rapana seashell, quail eggshell, mussel shell, receipt, boiled sausage, gerodietic nutrition.*

1. Introduction

At the end of the twentieth and the beginning of twenty first centuries the scientists of economically developed countries and countries that are developing became interested in gerontology (the study of the aging processes and factors which determine life expectancy of the people of advanced age, in particular the problem of nutrition in old age).
25% of citizens of Ukraine are pensioners, and 20% are more than 50 years old. Ukraine is on the eleventh place in the world among the countries with the share of citizens older than 65 years (Belarus - 23 place, Russia - 27). Statistics shows that the percentage of people of advanced age in Ukraine is 20.5%. The Institute of Gerontology of the Academy of Medical Science of Ukraine predicts that in 2015 it will be 22%, in 2026 - 26%, 2050 - 38% [1].
Main factors which cause fast ageing are:

- social: low level of income; lack of knowledge about basic characteristics of food products; insufficient level of medical aid; low level of social protection of citizens, and chronic stress;
- ecological: contamination of water, soil, air, and food products;
- incorrect way of life: bad habits; defective nutrition; insufficient afferent activity; incorrect work and rest regime;
- infections.

Typical Ukrainian in average consumes 20% less products that are prescribed in living wage, and 40% less than it was in 90th, the most unfavourable years of perestroika.
Conducted investigations in Ukraine [1, 2] show that daily ration of different groups of people consists of comparatively chip high carbohydrate products (bread, macaroni products, potatoes), as a result organism lacks essential micro and macroelements, polyunsaturated fat acids, anti-oxidizing vitamins (A, C, E).
There are two ways of solving the problem. First, using biologically active additives in food. Second, enrichment of traditional food products in order to raise the level of vitamins, macro and microelement content to current physiological needs of people, this will make possible to correct micronutrient deficit [3, 4, 5].

Production of gerodietic products is essential in some aspects: wide application of gerodietic products in a diet of advanced age people, elderly people, and long-lived people will help to correct defects of nutrition. The usage of gerontological products is very essential in a domain of medical nutrition not only for this group of people, but also for younger age groups as preventive measures for premature ageing.

Citation [1, 6] shows that in spite of multiple researches on creating of high nutrition and biological value products, their assortment is insignificant.

The pioneers in creating of balanced gerodietic products are: Antipova L.V., Bohatyriov A.N., Kozlovska S.H., Zaytsev A.N., Kasianov H.I., Samsonova M.A., Hrihorov Y.H., Povorozniuk V.V., Chebotariev D.F., Nechayev A.P., Lipatov N.N., Pokrovskiy A.A., Skurykhin K.M., Uholiev A.M, Ustynova A.V., Kharytonov V.D., Shazzo R.I. etc.

The urgent problem of present time is a deficiency of calcium in daily ration that is why different scientists are looking for ways to enrich food products with calcium.

Leading scientists of dairy industry in Ukraine [Petrov A. N., Kovalenko N.K., Sharakhmatova T.E., 2001] developed a set of dairy gerodietic products which are not represented on market. The absence of these products is stipulated by a short expiration term (36 and 72 hours for milk and fermented milk drinks «Героклат» and «Лактогеровіт»); low profitability of production; low income of elderly people in Ukraine; absence of state policy in a sphere of gerodietic nutrition. There was created [Didukh N.A., 2008] a set of non-fermented and fermented gerodietic drinks (milk, kefir, sour milk, acidophilus milk) on milk and grain milk base, sour milk cheese and gerodietic sour cream.

To enrich macaroni products with calcium scientists [Koriachkina S. Ya., Osypova H. A., 2002] conducted a research on some components of a paste: gluconate, lactate, calcium carbonate and powder of eggshell.

Russian scientists [Savenkova T. V., Blahodatskikh V. E., Dukhu T. A., Shcherbakova N. A., Bashkirov O. I., 2009] with the help of computer modeling developed a technology of a pastry «Бисквитное» with a curd soufflé for gerodietic nutrition, and cookie on a base of functional additives [Tumanova A., 2006], specifically: kelp, calcium alginate, pectin and microcrystalline cellulose. New assortment of sweet products differs from traditional products with a high content of fibre foods and vital mineral materials, iodine and calcium.

Meat is perspective in production of gerodietic products, as much as this is the main source of protein for human's organism. Experts [Shypulyn V. I., Akhtemshyna A. D., Nekrasova N.N., 2009] developed a technology of production of meat foods using protein preparations based on whey.

All-Union Research Institute of Meat Industry (Moscow) developed a biologically active mineral organic additive made of horns of a reindeer, which should be added into boiled sausage products in order to enrich them with iodine and calcium. However this preparation is not widely used due to the insufficient amount of raw materials used for its production.

We are conducting researches on a possibility of using mineral additives made of mussel shells, rapana shells, and quail eggshells in a production of gerodietic products, specifically boiled sausages.

To enrich meat foods scientists [Faivyshevskiy M. L., 1998; Khabryna K. E., 1999; Ustynova A. V., 2000] suggest using natural sources of calcium: bone marrow meal, algin acid salt, bone paste.

The source of bioorganic calcium compounds is dietary bone, which is gathered on meat processing plants and is not used for nutrition as a source of calcium. Beliayev M.I., Cherevka O.I., Faivishevskiy M.L., Honcharov H.I., Vinokurova H.A. investigated a technology of extraction of protein, fat, bone marrow

and obtaining of meat out of bone stuff. In 2004 Holovko M.P. developed a method of processing a semi-finished product out of dietary bone of the cattle. This semi-finished product may be used for production of ground meat products enriched with bioorganic calcium compounds.

The food industry of Japan more than 20 years is using different methods of production of meat foods enriched with calcium by adding grounded animal bones into cutlet mince, schnizels, and sausage products. The food industry of USA conducts researches on creating of a protein mineral additive made of bone and bone leavings. In United Kingdom dietary bone is processed by Johnson-Faudler method to obtain food fat, soluble protein and food phosphate [7,8].

2. Experimental

When developing a technology of sausage products using bone additives, it is essential to identify its structure, structural changes of model sausage meat and final sausage products. The usage of the precise chemical, physicochemical, histological and biochemical methods allows to obtain information about quality of meat foods. Microstructural researches make it possible to analyze not only the integral structure of product, but also changes which occur in separate components of the objects under investigation, it also helps to differentiate peculiarities of different tissue and cellular structures. That is why the aim of our investigation was to study the possibilities of using the paste obtained by hydrothermal hydrolysis of bones in technology of boiled sausages, investigating microstructure of model sausage meat and final sausage products [9].

For production of sausages the receipt of boiled sausage «Столова» is used in accordance with ДСТУ 4436:2005. In created receipts we substituted 5 to 20% of 1st sort beef with a dietary bone paste. The modeling of receipt components and its percentage was made with a help of a computer program BIO.2.

After the analysis of different kinds of receipts it was stated that the increase of amount of bone paste will not balance the amino-accids and mineral components of a product, and the minimal amount will not balance calcium and phosphorus. By modeling the maximum value of the coefficient of utilitarity of amino-accids and the ratio of protein : fat : mineral elements, we have chosen 4 receipts of sausage meat for boiled sausages (table 1).

We have determined that it is not practical to use more than 40% of beef in meat products, because the cost increases, the product becames more tough and the level of digestion decreases. The concentration of beef less than 35% does not balance aminoaccid components. Thus the most optimal content of bone paste is 10% .

Table 1
Receipts of boiled sausages with different content of bone paste

Component	The amount of bone paste, %				
	Stolova	5	10	15	20
1st sort beef	49	44	39	34	29
Mild fat pork	50	50	50	50	50
Dried milk	1	1	1	1	1
Bone paste	-	5	10	15	20

The next stage was to investigate the microstructure of sausages with different amount of the bone paste. The investigation of biological tissues is more specific in comparison to native tissues, because we investigate the tissues that underwent mechanical and thermal processing [3, 5].

For histological investigations the samples of sausage products with dimensions 10x5x4 mm. and model sausage meat were fixed in 2.5% of gluteraldehyde on phosphate buffer (pH-7.4), samples were content for 24 hours in 4ºC. Then pieces were washed in phosphate buffer (pH - 7.3) for two hours. After this they were immersed into osmium fixator (G.M.Millonig [6]) for additional fixation

for two hours. Then the pieces of tissue are washed in 0,1M of phosphate buffer (pH - 7.3) for one hour. The next stage is to dehydrate the tissues in spirits of different strength (50%, 70%, 80%, 90% and the absolute spirit for 10 min. in each), then goes the mixture of spirit and acetone (3:1, 2:1, 1:1, 1:2, 1:3 – 15 min. each). After the samples are washed, they are processed under Laft method [6], and pouredwith Epon - 812. The cuts were made on ultramicrotome УМТП-7 by aimed microtoming. Before colouring, the object-plate with the cut was kept in thermostat in 45-50ºC for better fixation on the object-plate. For colouring was used the 0.1% mixture of toluidine blue. Morphometric analysis was done with the light optical microscope "МБІ-15".

3. Results and Discussion

Conducted histological investigations made it possible to determine the next microstructure rates of model sausage meat and finished sausage products. Histocuts of the samples of model sausage meat (figure 1) are small-grained and uniform (2) with big vacuoles (4), which are filled with fat, they are bright coloured, because fat was partially dissolved in the process of washing in spirit mixtures, but not in all the samples. Sausage meat contained connecting tissues, (3) where intact muscular fibres can be find (1), this makes possible to determine the components of sausage meat (figure 1).
Histocuts of finished sausages (figure 2) contained coagulation layer (1), increase of vacuoles size (2), homogenous mass of glutin - the product of thermal disintegration of collagen of the connecting tissue (3), which is less sensitive to histological dyes (figure 2).

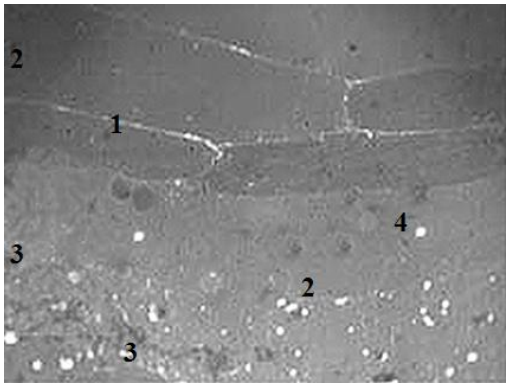

Figure 1. Microstructure of sausage meat (sample 15x40)

In figures 3 and 4 are presented the images of histocuts of sausage meat and final sausages with 5% of bone paste. In the figure an insignificant increase of size of vacuoles and individual inclusions of evenly placed particles of bone paste can be seen.

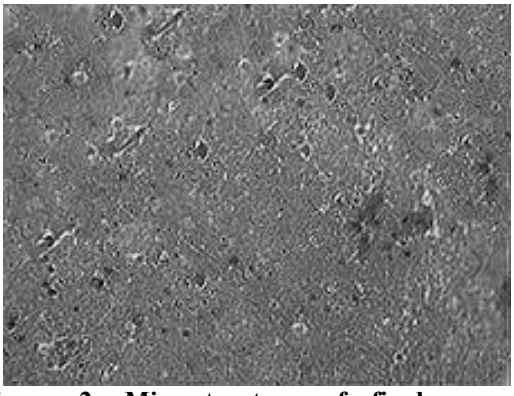
Figure 2. Microstructure of final sausage (sample 15x40)

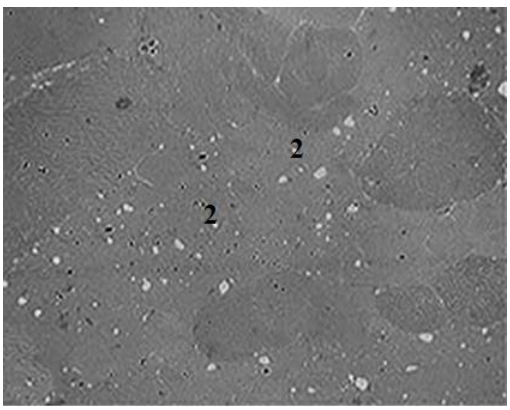

Figure 3. Microstructure of sausage meat with 5% of bone paste (15x40)

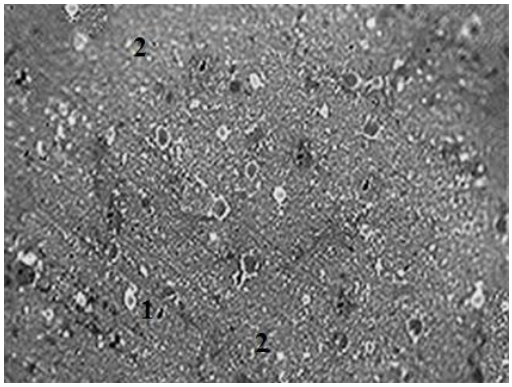

Figure 4. Microstructure of final sausage with 5% of bone paste (15x40)

Meat sausage which contained 10% of bone paste (figure 5) has small-grained uniform structure with evenly placed particles of the bone paste and vacuoles, which are less vivid than in previous sample. Final sausages have compressed coagulation layer, the fat is evenly distributed in vacuoles and in uniform protein mass (figure 6). Organoleptic rates show that this sausage is juicier, has elastic consistence, is palatable, without aftertaste of bone paste. Sausage meat with 15 and 20% of bone paste has soft structure with big vacuoles filled with fat (figures 7, 9).

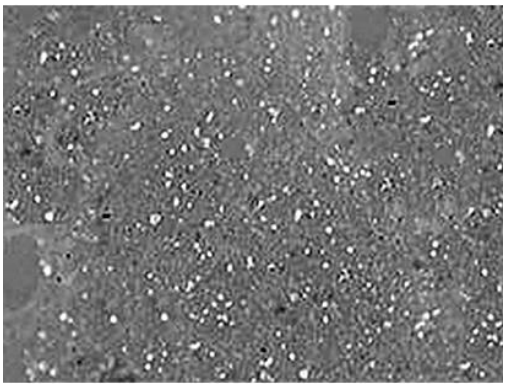

Figure 5. Microstructure of sausage meat with 10% of bone paste (15x40)

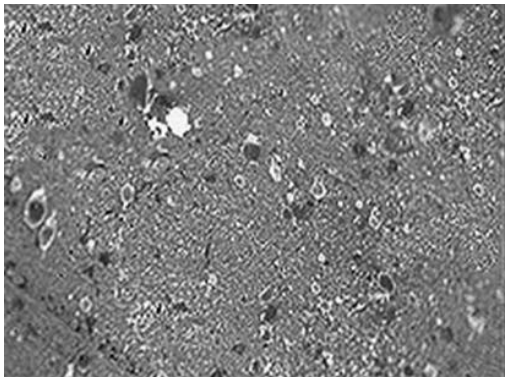

Figure 6. Microstructure of final sausage with 10% of bone paste (15x40)

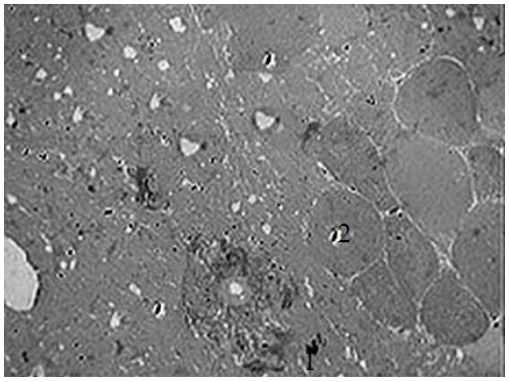

Figure 7. Microstructure of sausage meat with 15% of bone paste (15x40)

Data on figures 7, 9 shows considerable amount of intact connecting tissue (1), which increase the amount of bone paste particles. Organoleptic rates show that this sausage is soft, has specific aftertaste and watery consistency. The microstructure of finished sausage products has powdery structure and big amount of unstabilized fat and vacuoles (figures 8,10). Thusly the change of the ratio of muscular and connecting proteins and adding big amount of paste to increase amount of fat causes deterioration of the quality of final sausage products [7].

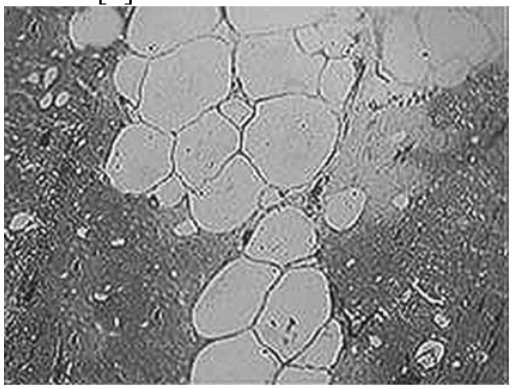

Figure 8. Microstructure of finished meat with 15% of bone paste (15x40)

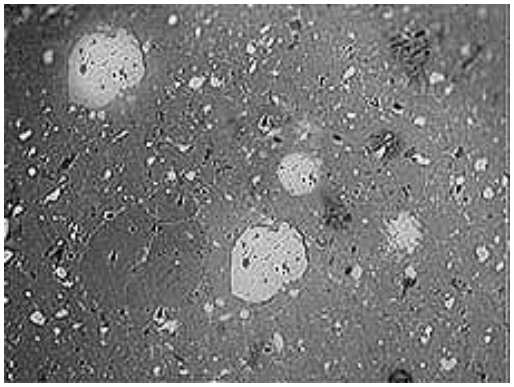

Figure 9. Microstructure of sausage meat with 20% of bone paste (15x40)

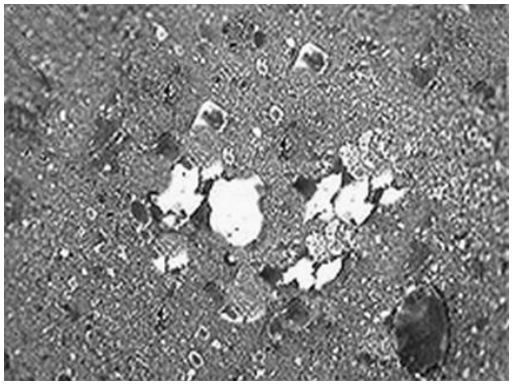

Figure 10. Microstructure of finished sausage with 20% of bone paste (15x40)

4. Conclusion.

The results of previous physicochemical and organoleptic investigations showed that bone paste can be used in the food industry.
The investigation of the microstructure of sausage meat and final boiled sausages produced using model receipts, shows that addition more than 15% of bone paste to the content of the product results in powdery structure of finished sausages.
It is proved that the optimal amount of the bone paste in finished product is 10%.

5. References

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