THE ROLE OF ACTIVIZED WATER IN THE TECHNOLOGY OF MEAT PRODUCTS MANUFACTURING

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SUMMARY

During testing of units for activation of water and solutions, containing 1 g of NaCl per 1 l of liquid, the optimum parameters were established: voltage V=60, activation time = 4 - 4.5 min.

Bactericidal properties of analyte were studied during treatment of hot carcasses and of sausages after cooking and shelf-life of products treated with analyte at higher temperatures (to + 12°C) was determined. Besides, the influence of catolyte on pH of ground meat and on its water-holding abilities was studied along with the effect of catolyte on the improvement of yield of finished products preserving high organoleptical indices. Experiments were conducted on the use of analyte and catolyte during preparation of ground meat mixtures, which showered that the above-mentioned treatment ensures high level of sanitation and reduction of total bacterial load.

INTRODUCTION

Among other substances available in the world, water, due to peculiarities of its physical and chemical properties, plays a very important role in biological life of any living-being. However, to the present moment many properties of this amazing substance are still unknown. Water, being a compositional part of food products, influences significantly their quality. Meat contains 70-75% of water; besides, during manufacturing of cooked sausages, 25-40% of water is added into emulsions. Efficiency of meat products manufacture in a great extent depends on the ability of raw material to bind and to hold the necessary amount of water. The latter is defined by properties of raw material and by technological approach to production of meat products, properties of the used water may also contribute to final quality of products.

It is known that at different mechanical, electromechanical and other effects, water changes its properties and acquires new ones. One of the most effective method of water activation is application of electric current.

The studies of the mechanism of electrochemical activation and of properties of activized water are being conducted in the All-Union Meat Research Institute (Gorbatov, Pirogovsky, Limonov et al.,) and in the Moscow Institute of Applied Biotechnology (Rogov et al.).By these institutions experimental activators were designed and the Kokand engineering plant launched lot production of units for electrochemical activation of water with the following pH-values: for analyte = 2, for catolyte = 12.

During storage in open vessels pH of activized solutions changes on the third day, in closed ones - on the fifth day. After boiling the activized solutions do not change either activity or pH.

When analyte (pH=2) and catolyte (pH=12) are mixed, the mix acquires pH = 6.5-7.2, i.e.

becomes neutral, however, preserving its bactericidal properties.

In order to maintain high sanitation level of products manufacture, complex cleaning and disinfection of equipment and of production areas are done, this requiring a lot of water and of chemical detergents (active chlorine, caustic alkali, etc.).

Activized water with pH=12 (catolyte) possesses properties of a common detergent and water with pH=2 (analyte) shows bactericidal properties, it has no off-flavour, is harmless to human organism.

Treatment of equipment with activized water (pH=2) is similar to the effect of disinfectic solutions by its efficiency.

One of the main problems connected with sausage manufacture is water-holding ability of meat. In CIS (Commonwealth of Independent States) content of moisture in cooked sausages and frankfurters is maintained at the level of 75%. To achieve this level various additive are used: phosphates, flours, vegetable proteins, starch, etc, however, this level is diffi cult to achieve. In order to improve water-holding ability of cooked sausages, different methods were developed, one of them - increasing of diameters of sausage casings.

The use of phosphates implies certain problems too. Neutral phosphates are not effective, alkaline phosphates shift pH of the medium into alkaline region. The level of hydration is improved, though products acquire unpleasant off-flavour and their shelf-life is signifi- cantly reduced.

Catolyte possesses strong alkaline properties and with its help, avoiding the use of phos- phates, pH-value of the processed raw material can be regulated.

MATERIALS AND METHODS

Research was conducted in two directions: 1. The use of analyte for surface treatment of sausage loaves aiming at prolongation of their shelf-life.

2. The use of analyte and catolyte during production of cooked sausages for improvement of their water-holding ability and shelf-life of finished products.

1. "Molochnaya" 1 grade sausage in artificial casings (cellophane, diam.=100 mm) served object of research. After cooking finished sausage loaves were divided into two batches: test and control ones. Controls were cooled by tap water with 17-18°C during 3 minutes. Loaves of the test batch were showered by analyte with 20-21°C during 3 minutes too. Samp- ling and analysis of total bacterial load on the surface of sausages of test and control batches were performed. Loaves were stored at 12-14°C 5 days, after that one more analysis of total load was done. Results of studies are given in table 1.

As it is seen from table 1, total load on the surface of loaves after treatment by analyte is reduced by 2-6 times, in case of controls - by 1.3-1.5 times. After 5 days of storage at 12-14°C, total load on the surface of controls equalled 95-130 • 1 cm^2, of test samples 35 - 90 • 1 cm^2. These data prove usefulness of application of analyte for surface treat- ment of sausages for lowering of total microbial load and for improvement of stability of products during their storage.

Table 1

The influence of analyte on shelf-life stability of cooked sausages

Type of sausage	Batch	Temp. of water, °C	pH of water	t° of air during storage, °C	Total load on the surface of loaf (number/1cm²)		
					before treat.	after treat.	after 5 days of storage
Cooked 1st grade "Molochnaya" sausage	control	17	7	14	100	60	95
	test	20	2	14	80	10	35
	control	18	7	12	150	90	120
	test	21	2	12	180	60	90
	control	18	7	12	140	80	130
	test	20	2	12	145	40	80

2. Research was conducted aiming at application of catolyte to shift pH of the sausage emulsion into alkaline region according to the following method:

- Formulation and technology of production of "Dorozhnaya" cooked sausage were not changed, however, pH of the added water varied;
- Emulsion was stuffed into the same casings (cellophane, diam. =100 mm);
- 0.3% of phosphates were added into emulsion of control samples;
- Test samples contained no phosphates, 30% of the added water was replaced by catolyte with pH=12.

Further treatment of control and test sausage batches was conducted under similar conditions. Results of studies are given in table 2.

Table 2

pH of sausage emulsions as dependent on phosphates or catolyte addition

Type of sausage	Batch	Mean pH-value of raw material	pH of water	pH-value of sausage emulsion	
				after addition of phosphates	after addition of catolyte
Cooked 1st grade "Dorozhnaya" sausage	control	6.0	7.0	6.5	-
	test	6.0	12	-	6.5
	control	5.7	7.0	6.3	-
	test	5.7	12	-	6.2
	control	5.8	7.0	6.3	-
	test	5.8	12	-	6.3
	control	5.7	7.0	6.2	-
	test	5.7	12	-	6.2
	control	5.8	7.0	6.3	-
	test	5.8	12	-	6.3
	control	5.7	7.0	6.2	-
	test	5.7	12	-	6.2

As it is seen from the table, the use of catolyte at the level of 30% of the total amount of added water allows to achieve effect of phosphates, added to meat emulsion at the level of 0.3%.

pH in both cases increases by 0.5 units. However, taking into consideration that analyte possesses bactericidal properties, we conducted series of tests in order to check the effect of successive use of analyte and catolyte for disinfection purposes and for enhancing of water-holding abilities of meat emulsions.

RESULTS AND DISCUSSION

At the first stage of chopping of the low-fat raw material, analyte (at the level of 30% of the total amount of the required water) with pH=2 was added for bactericidal treatment of meat. Meat was processed in a bowl cutter for 2-3 minutes. After that the rest of the raw material was added and chopping continued another 2 minutes. pH of the ground meat dropped to 5.4-5.2. Then, instead of the remaining 70% of water, catolyte with pH=12 was introduced into ground meat in order to shift pH into alkaline region and chopping continued 2 minutes more after all the necessary spices were added. Further treatment and technological procedures were the same for control and test sausages.

Treatment of sausage emulsion at the first stage of chopping with analyte (pH=2) decreased total microbial load of 1 g of emulsion from $5.0\text{-}5.8 \cdot 10^3$ to $3.0\text{-}4.1 \cdot 10^2$. Addition of 70% of catolyte (pH=12) shifted pH of emulsion from 5.8-6.0 to 6.45-6.6, increasing mass share of moisture by 3% in test samples, and accordingly increasing yield of finished products by 3%. During 3 days of storage at 12°C, total microbial load in 1 g of control samples increased by $2.0 \cdot 10^3$ and practically didn't change in the test ones. These data evidence that the above-mentioned combined treatment of sausage emulsion by catolyte increases water-holding ability of ground meat and total yield of finished products and improves their shelf-life stability.

CONCLUSION

In the process of studies regimes of activation of water and of solutions were chosen. Degree of activation was evaluated according to the change of pH-value.

During assessment of preservation of abilities of activized solutions it was established that analyte is more stable and preserves its activity longer, than catolyte. Activity of solutions is preserved longer in closed vessels. It was established that when analyte (pH=2) and catolyte (pH=12) are mixed, the solution acquires pH=6.5-7.2, that is becomes neutral. However, this mixture possesses bactericidal properties.

Activized water with pH=12 (catolyte) shows properties of a common detergent and water with pH=2 (analyte) - of a bactericidal preparation, it is odourless, causes no irritation of skin and respiratory tract.

Post-slaughter treatment of carcasses by analyte reduced total bacterial load significantly and even after 8 days of storage at 0 - 4°C total load didn't increase.

When sausage loaves were treated by analyte, total bacterial load reduced significantly and the product became more stable during storage.

Further research on the use of analyte and catolyte is needed as well as industry-scale testing of units for activation of solutions.