

Inhibition of volatile N-nitrosoamine formation in meat products

KARMYSHOVA L.F., SAFRONOVA G.A., MIKHAILOVA M.M., PETRAKOVA A.N. and ZHUKOVA G.F.\*

The All-Union Meat Research Institute, Moscow, USSR

\*The Institute of Nutrition of the USSR AMS, Moscow, USSR

Food safety and high sanitary-&-hygienic characteristics are an obligatory condition for consumers' health strengthening. Any effort aimed at it can contribute to the elimination of many diseases of man.

Special attention here should be drawn to lowering nitrosoamine (NA) levels in foods, including meat products.

A feature of these carcinogenic compounds is their ability to be formed from noncarcinogenic precursors, viz., nitrites, amines and amides, especially during cooking /1/. This is extremely important for meat products since during their processing sodium nitrite is used, and other NA precursors are natural components of meat. Treatment with smoke, containing nitric oxides, also contributes to the process of nitrosation. With view to the above-said, a search for ways of reducing NA levels in meat products is becoming very important.

At present it is impossible to eliminate sodium nitrite completely from meat curing because of its favourable effect upon meat products organoleptical qualities and its capacity to prevent poisoning caused with *Cl. botulinum*. It seems that most prospective is the inhibition of NA formation from precursors.

A great number of substances suggested as NA inhibitors are reported /2-5/. As most promising those can be indicated which are of a considerable inhibiting power and able of improving (or, at least, of maintaining) medico-hygienic and organoleptical properties of the finished products.

This paper presents results of a study into volatile NA formation in meat products and into the possible ways of their prevention. It was established that NA can be reduced through the use of substances which can inhibit nitrosation or via changing smoking procedure since the maximum amount of NA in meat products is formed at this very processing stage.

As substances capable of preventing nitrosation, ionol, ascorbic acid and the liquid smoke "VNIIMP" which allows to eliminate conventional smoking.

Experiments were performed on laboratory models of a "Stolovaya"-type cooked sausage, and on a commercially-produced cooked-&-smoked "Lyubitelskaya" sausage under production conditions. Every sample was used in 6 series of experiments.

Inhibitors were added to sausage batter as fat or water emulsions (see Table). Sausages without additives served as controls. Volatile NA in the finished products were determined by means of their isolation with steam distillation from the alkaline and afterwards from

the acid media, followed with methylene chloride extraction. NA levels were quantified with GLC using a thermoluminescent detector TEA-502 ("Thermo Electron Corp.") /6/.

N-nitroso dimethyl amine (NDMA) were identified in the tested products. The inhibiting effect of all the compounds was calculated by the total content of all the NA mentioned above. The results on volatile NA in cooked and cooked-&-smoked sausages as effected with ionol, ascorbic acid and liquid smoke are given in the Table below.

Table

Volatile N-nitrosamines in test sausages prepared with different additives, mcg/kg

Additives and their level, % of the batter	Tested sausages	NDMA	NDEA	Total NA	Inhibiting effect, %
Control	Cooked	1.3	0.4	1.7 ± 0.26	0
	Cooked-&-smoked	1.7	1.1	2.8 ± 0.93	0
Ascorbic acid, 0.05	Cooked	0.9	0.2	1.1 ± 0.45	35
	Cooked-&-smoked	1.1	0.8	1.9 ± 0.49	32
Liquid smoke "VNIIMP", 0.30	Cooked	0.9	0.3	1.2 ± 0.41	30
	Cooked-&-smoked	1.2	0.6	1.8 ± 0.51	36
Ionol (tert-butyl-oxytoluol), 0.01	Cooked	0.6	0.2	0.8 ± 0.48	47
	Cooked-&-smoked	1.0	0.5	1.5 ± 0.36	46

According to the data obtained, volatile NA spectra both in test and control sausages are similar and consist of NDMA and NDEA. All the additives inhibit NA formation in the finished products, ionol being most effective: it lowers the total NA, on the average, by 46%.

The inhibiting effects of ascorbic acid and liquid smoke are very similar: NA in the product are reduced by 32-35 and 30-36%, respectively.

All the products were evaluated organoleptically. Test samples prepared with the above inhibitors met standard requirements and did not differ from controls.

Thus, the use of some compounds, capable of inhibiting the process of nitrosation, and conventional smoke elimination from the processing technology allows to decrease carcinogenic NA in the finished product without affecting its organoleptical qualities. It improves significantly product sanitary-&-hygienic characteristics and is extremely important from the social point of view.

References:

1. Lijinsky W. Carcinogenesis by exposure to nitrite and amines. In: Nitrosamines and human cancer. Ed. Magee P.N., Cold Spring Harbor Laboratory, 1982, - P. 121-140
2. Kotter L., Schmidt H. Aktuelle Betrachtungen Uber Zusatzstoffe bei Fleischwaren aus qualitativer, hygienischer, technolischer und Lebensmittelrechtlicher Sicht. - Fleischwirtschaft, 1983, v.63, N° 9.-S. 1384, 1387-1392.
3. Bharuchta K.R., Cross C., Rubin L.J. Acetals and ketals of ascorbic acid and anti-nitrosamine compositions and methods using same, USA Patent 4.153.613, 1979, 260/340, C 07 D 317/10.
4. Coleman M.N. Control of nitrosamine formation in nitrite cured meat. USA Patent 4.073.153, 1978 426/266, a 23 B 4/02.
5. Mergens W.J., Kemon J.J., Newmarn H.L., Fiddler W., Pensebene J. Alpha-tocopherol uses in preventing nitrosamine formation. - IARC Sci. Publ., 1978, N 19. - P 199-212.
6. Bogovski P., Rooma M., Ulbu J., Kann J., Tauts O. Research on environmental N-nitroso compounds in the USSR. - IARC Sci. Publ., 1982, N 41. - P. 259-266.

amino acids, %	Control	Test
<b>Essential</b>		
lysine	5.10	5.77
tryptophan	0.25	0.07
valine	1.75	1.85
methionine	0.86	0.22
iso-leucine	1.40	1.48
leucine	1.40	1.28
phenyl-alanine	0.86	1.27
	12.82	12.97
<b>Replaceable</b>		
histidine	1.40	1.43
arginine	0.75	1.22
aspartic acid	0.25	0.25
serine	0.25	0.25
glutamic acid	11.00	12.00
proline	1.40	1.43
glycine	11.00	11.48
alanine	1.40	0.25
tyrosine	0.86	0.25
	31.75	35.78
<b>Total</b>	<b>44.57</b>	<b>48.75</b>
<b>Protein, g</b>	<b>720</b>	<b>84.3</b>

It was established that the test sample with 2% nitrite showed a higher value of nitrosamines than the control sample. To study the substitutive value of the product, experiments were performed on accelerated salt curing weighing 48-50 g, randomly divided into 2 groups (20 units in each) Group 1 was fed with the standard ration throughout the 48-day experimental period, group 2 was given the same ration with 20% of the test cure. A test cure was added during the curing process. A synthetic mixture of amino acids added to the ration was similar to those of the test cure. All the units were weighed and their moisture and protein content determined after curing.

As is clear from table 2, that salt incorporation into the standard ration resulted in a progressively increasing rate of nitrosamine formation. The higher salt incorporation led to an increase in nitrosamine formation, especially during the first 24 hours of the experiment.