

# INFLUENCE OF NITRATES ON MEAT QUALITY WHEN FATTENING PIGS FOR MANUFACTURE OF BABY FOODS

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## Introduction

Higher requirements for baby foods dictate the necessity of using high-quality ecologically clean meat raw materials for their production. The pork meat makes the greater part of it.

The child's organism, especially in early age, is sensitive to impurities of noxious chemical substances, among which are nitrites and nitrates – the predecessors of formation of carcinogenic nitrosamines, in foods.

## Objectives

The objective of this investigation was to study the content of nitrosamines in the meat of pigs during fattening of which rations with different contents of nitrates were used.

## Materials and Methods

Isolation, identification and quantitative determination of nitrosamines were carried out by the hemiluminescent method. The structure of compounds was selectively confirmed by the mass-spectrometry method. In carrying out of the above investigations the Institute of Nutrition of RAMN (Dr. of Biological Sciences G.F. Zhukova) took part.

Three groups of pigs, each one consisting of 12 animals, were tested. The first group received the ration containing nitrates at the level of maximum permissible concentration (MPC) – 500 mg/kg of feed, the second group – 2 MPC – 1000 mg/kg of feed, the third (control) group – low-nitration ration from 0 to 100 mg/kg of feed during 20 days.

The animals were slaughtered at the end of the accumulating period of nitrates – in 20 days. In all, 4 slaughters (on the 1st, the 5th, the 15th and the 20th day on completion of the accumulating period) took place. Samples of muscles (ground meat) and united samples of internal organs (heart, kidneys, liver) were drawn (3 samples from 3 animals of each slaughter) and tested for the presence of volatile nitrosamines in them: N-nitrosodimethylamine, N-nitrosodiethylamine, N-nitrosodipropylamine, N-nitrosodibutylamine, N-nitrosopiperidine, N-nitrosopyrrolidine.

## Results and Discussion

In all samples mainly N-nitrosodimethylamine and N-nitrosodiethylamine were found; N-nitrosopiperidine and N-nitrosopyrrolidine were found in meaningless quantities. Average values of the summary content of nitrosodimethylamine and nitrosodiethylamine are given in Table 1.

Table 1. Content of nitrosamines in the samples of tissues and internal organs with respect to each group of four slaughters

Sample		Nitrosamines (μG/kg) in the samples of animal groups		
		1	2	3
Muscles	the first slaughter	1.13 ± 0.05	2.06 ± 0.10	0.96 ± 0.04
	the second slaughter	2.09 ± 0.09	5.21 ± 0.02	0.72 ± 0.03
	the third slaughter	0.65 ± 0.03	1.73 ± 0.01	0.56 ± 0.03
	the fourth slaughter	0.84 ± 0.04	1.44 ± 0.01	0.46 ± 0.02
Internal organs	the first slaughter	0.94 ± 0.04	0.77 ± 0.03	0.72 ± 0.03
	the second slaughter	0.70 ± 0.03	1.03 ± 0.05	0.40 ± 0.02
	the third slaughter	0.42 ± 0.02	1.93 ± 0.09	0.53 ± 0.02
	the fourth slaughter	0.33 ± 0.01	0.67 ± 0.03	0.54 ± 0.02

Higher level of nitrosamine contents was discovered in the tissues of test animals hold on the ration with a high content of nitrates in feed (100 mg/kg of forage) and the animals killed in 4 and 14 days after the accumulating period.

On the contrary, low content of nitrosamines (not more than 1 μG/kg) was established in the samples of tissues and organs received from the animals of the control group hold on the low-nitrate ration.

Pays attention to itself the fact that united samples of internal organs of animals contain less nitrosamines, as compared to the muscles of animals from the corresponding group and slaughter. This circumstance can be explained, evidently, by the fact, that the heart, kidneys and, especially, liver are rich in enzyme systems metabolizing nitrosamines, what, probably, leads to fast destruction of these carcinogens in internal organs.

Also it is necessary to mark significant differences in the total amount of nitrosamines in separate samples of tissues and organs in some groups of animals. The above differences are explained by individual features of each animal, namely, by its microbiological status, state of health, individual amount of consumed feed, etc. – the facts on which can depend the number of endogene-forming nitrosamines. Evaluating the mean results of nitrosamine content analyses, one may clearly observe a higher content of carcinogenic nitrosamines in the tissues and organs of test animals. It is necessary to note a more favorable picture when evaluating the level of nitrosamine content in the first and third groups in which feeds for animals contained standard amounts of nitrates as well.

Attracts attention the fact of changing of nitrosamine content (in the direction of reduction) in the samples obtained from the meat of animals hold during a longer period of time on the usual ration after the accumulating period. As findings testify, the content of nitrosamines in the samples of organs and tissues is reduced reaching the level of control samples.

At the end of the 20-day nitrate load period the content of nitrosamines in the meat of pigs from both test groups exceeded MPC for child nutrition (1  $\mu\text{G/kg}$  of meat) and averaged 1.13  $\mu\text{G/kg}$  - in the first and 2.06  $\mu\text{G/kg}$  - in the second group.

After stopping the usage of the feed with nitrate load, the concentration of nitrosamines in the meat of pigs from test groups went on growing and reached its maximum value on the 5<sup>th</sup> day – 2.09 and 5.21  $\mu\text{G/kg}$ , respectively.

On the 15<sup>th</sup> day after termination of nitrate load the content of nitrosamines in the meat of pigs from the first test group amounted to 0.65  $\mu\text{G/kg}$ , what was lower than maximum permissible level. In the meat of animals from the second group the level of nitrosamines considerably exceeded MPC – 1.73  $\mu\text{G/kg}$ .

The content of carcinogenic N-nitrosamines in the meat of pigs from the control group during all the test varied on the average in the group from 0.46 to 0.96  $\mu\text{G/kg}$ , what is lower than MPC for child nutrition.

Feeding younger pigs with combined fodder with the content of nitrates 100 and 500 mg/kg didn't result in their significant accumulation in tissues. Nitrates were revealed as traces, and nitrites were not revealed. However, already on the 5<sup>th</sup> day formation of endogene nitrosamines in the muscular tissue whose number depends on the content of nitrates in feeds, took place. Nitrosamines were retained in muscles up to 25 days, even after the change-over of animals to the ration of the control group. In the internal organs such dependence wasn't observed (Table 2).

Table 2. Content of nitrates and nitrosamines in meat of pigs

Group number	Nitrates, mg/kg		Nitrosamines in meat after change-over of all animals to the ration of the 1 <sup>st</sup> group, $\mu\text{G/kg}$		
	in the ration	in meat (min-max)	in 5 days ( $M\pm m$ )	in 15 days ( $M\pm m$ )	in 25 days ( $M\pm m$ )
1	100	0-0.39	$0.80 \pm 0.04$	$0.60 \pm 0.03$	$0.70 \pm 0.05$
2	500	0-0.54	$3.20 \pm 0.08$	$2.50 \pm 0.06$	$0.90 \pm 0.02$
MPL	500	not regulated	<1.00	<1.00	<1.00

Thus, the findings made possible to establish that the existing regulation for the content of nitrates in combined feeds at the level of 500 mg/kg didn't allow to produce pork of the required quality due to formation of nitrosamines in muscles in the amounts exceeding maximum permissible levels (MPL). It was determined that the content of nitrates in combined feeds for pigs within the final period of fattening shouldn't exceed 100 mg/kg at the farms supplying pork meat for production of baby foods.

### Conclusion

1. Feeding of animals (pigs) whose ration contains supernormal amount of nitrates leads to the increase in the content of nitrosamines in their tissues.
2. No significant differences in the content of nitrosamines in the samples of united internal organs of animals from different groups were determined.
3. Holding of pigs from test groups during a long period of time on the feeding ration containing standard amounts of nitrates leads to normalization of the level of carcinogenic nitrosamines in the organs and tissues of animals.
4. To produce pork of the required quality for child nutrition (with the content of N-nitrosamines less than 1  $\mu\text{G/kg}$ ) it is necessary:
  - to reduce MPL of nitrates in the used feeds up to 100 mg/kg, or
  - at the used level of nitrates of 500 mg/kg of feed to stop utilization of such fodder not less than 15 days before slaughter.