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INHIBITORY ACTION OF DIFFERENT CONCENTRATIONS OF NaCl USED IN MEAT PROCESSING ON BREATHING ACTIVITY OF STR.FAECALIS

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Summary,

The inhibitory action of NaCl is studied in concentrations of 1,8; 2,2; 2,5; 2,8; 3,0; 3,2; 3,5; 3,8; and 4,0 percent, on the activity of breathing of Str.faecalis. It is found that with an increase of NaCl concentrations, there is a marked decrease in breathing.

The demonstrated inhibitory action of NaCl on exogenic breathing activity has a definite influence upon the bacteriostatic effect on Str.faecalis, which in turn plays a vital role in the production of canned meat.

ИНГИБИРУЮЩЕЕ ДЕЙСТВИЕ РАЗЛИЧНЫХ КОНЦЕНТРАЦИЙ NaCl, ИСПОЛЬЗУЕМЫХ В ПРОИЗВОДСТВЕ МЯСНЫХ ПРОДУКТОВ, НА ДЫХАТЕЛЬНУЮ АКТИВНОСТЬ КЛЕТОК STR.FAECALIS

Резюме

Исследовано ингибирующее действие NaCl в концентрациях: 1,8; 2,2; 2,5; 2,8; 3,0; 3,2; 3,5; 3,8 и 4,0% на дыхательную активность клеток Str.faecalis.

Установлено, что при повышении концентрации соли наблюдается угнетение дыхания.

Доказанное ингибирующее действие NaCl на активность экзогенного дыхания играет определенную роль при его бактериостатическом эффекте в отношении клеток Str.faecalis, что имеет важное значение при производстве мясных продуктов.

DIE HEMMENDE EINWIRKUNG DER IN DER FLEISCHVERARBEITUNG ÜBLICHEN KONZENTRATIONEN DES KOCHSALZES AUF DIE ATMUNGS-AKTIVITÄT BEI STR.FAECALIS

Zusammenfassung

Untersucht wurde die hemmende Einwirkung des Kochsalzes in Konzentrationen von 1,8%, 2,2%, 2,5%, 2,8%, 3,0% und 4% auf die Atmungsaktivität bei Str.faecalis.

Dabei wurde festgestellt, dass mit der Erhöhung der Konzentration des Kochsalzes die Atmung gehemmt wurde. Die hemmende Einwirkung des Kochsalzes auf die Aktivität der Exogenatmung ist von grosser Wichtigkeit für den bakteriostatischen Effekt auf Str.faecalis und gleichzeitig auch von grosser Bedeutung für die Herstellung von Fleischkonserven.

The preserving properties of salt as yet is not fully elucidated. Some authors accept it as a result of the plasmolyses, salt evokes in microorganisms. Established is however, that plasmolyses continues for only several hours, and for that reason some bacterial cells rest unaffected (12). There is an opinion that the preserving property of salt is the result of at least five factors: dehydration, direct action of the chlorine ion, decrease of oxygen, augmenting the sensibility towards carbon

dioxyde, and hindering the fast action of the proteolytic enzymes (4,7,10).

According to other authors, the preserving action exhibited by the salt is due to the high osmotic pressure, which results when it dissolves in the juice of the product (1).

After the introduction of the conception "water activity" by Scot (1953), some authors bind the action of NaCl upon the microorganisms with its property to decrease water activity (3,9).

Interesting results are obtained in studying the synthesis of protein in *E.coli* after gamma irradiation in the presence of NaCl.

It is proved, that NaCl increases the induced by gamma irradiation ($4,8 \cdot 10^4$ rad/h) mortality of *E.coli* cells. At the same time is observed a stronger inhibitory effect by including the C^{14} -aminoacids in the not soluble trichloroacetic fraction in cell irradiation in the presence of NaCl, rather than in its absence. This exhibited effect of gamma irradiation in the presence of NaCl upon the synthesis of protein is augmented with the augmentation of the irradiation doses and the concentration of NaCl. It has been proved that high NaCl concentrations alone, without the combined action with irradiation, have a clear inhibitory effect in the protein synthesis (10).

In relation to the different kinds of microorganisms the preserving effect of salt is different, apart from this a strong factor on the influence of NaCl is the media in which it acts. It is proved that in different media one and same concentration of edible salt, acts differently inhibitory on microbial cells (12). It is established that in the presence of nitrates the preserving action of salt is augmented. (2).

Studying the fixation of CO_2 by the extracts of *Str.faecalis* var. *liquifaciens*, it is established, that when adding the dialysed extract of the cells of NaCl, is observed inhibition to the fixation of CO_2 . It is believed, that fixation of CO_2 in this microorganism is effected with the immediate participation of pyruvatecarboxylase (4).

Analysing the data found in the available literature about the preserving action of NaCl, could be said, that the mechanism of action upon the sensible microorganisms, is at present not altogether elucidated.

In our present work are presented materials about the influence of NaCl in concentrations as generally used in meat processing, on the oxydation property of *Str.faecalis*.

Methodics.

The present investigations we have made with suspension of 6 and 16 hours cultures of *Str.faecalis* var.*liquefaciens*, strain 755.

The biomass from the liquid nutritive media we separated (6) by centrifugation and double washing with physiological solution(11).

The respiratory activity of the microbial cells we determined by the manometric method of Warburg. The tests were carried out with intact cells, cultivated under stationary conditions and washed with sterile physiological solution. With view of determining the oxydation ability of the culture, 1 ml from the suspension was put in the basic reservoir of the Warburg vessel. For gas environment we used air. For the absorbtion of CO_2 we used 0,2 ml 20% solution of KOH, which was poured in the inner vessel. In determining the respiration of the cells, and for the account of endogenic substances, to 1 ml suspension were added 2 ml phosphate buffer (pH 7,4). In dterming the respiration in the presence of different substances, to 1 ml suspension was added 1 ml phosphate buffer and 0,5 ml from the corresponding substrate. The NaCl solutions were introduced in the side arm in 0,5 ml quantity, with precalculated concentrations,corresponding in dilution to 3,2 ml (total volume of the liquid in the vessel) applied in meat processing : 1.8%, 2.2%, 2.7%, 2.8%, 3.0%, 3.2%, 3.5%, and 4.0%.

As exogenic substrates were used glucose (0,6% s-n), lactic (3.0% s-n) and ascorbic (0.12% s-n) acids in concentrations, which in dilution to 3,2 ml correspond to those practically existing in the meat products (correspondingly 0,1%, 0.5%, and 0.02%).

As an index for the respiration activity served us the quantity of the used for 1 hour oxygen, related to 1 mg cell carbon.

The determination of the used by the streptococci oxygen we made without taking in consideration the intensity of the endogenic respiration, as the respiratory activity of these bacteria without oxydazing substrates in our tests, practically was not exhibited.

Results and Discussion.

In table 1 are presented data for the influence of different NaCl concentrations on the intensity of absorbtion of the oxygen by the cells of *Str.faecalis* var.*liquesfaciens*.

Data shown on table 1 elucidate that with adding to the suspension of cells from *Str.faecalis*, different concentration of NaCl

Inhibitory action of different concentrations NaCl
upon the respiratory activity of 6 hour old *Str.*
faecalis var. *liquefaciens*, cultures.

Table 1

Concentrations of NaCl in %		% respiration inhibition		
		Glucose	Lactic acid	Ascorbic acid
Control		0	0	0
Test	1.8	15.12	93.28	100.0
"	2.2	20.74	100.0	100.0
"	2.5	25.58	100.0	100.0
"	2.8	36.79	100.0	100.0
"	3.0	41.14	100.0	100.0
"	3.2	43.53	100.0	100.0
"	3.5	48.41	100.0	100.0
"	3.8	69.95	100.0	100.0
"	4.0	93.51	100.0	100.0

exhibit expressed inhibitory action on oxygen absorption by these organisms. Glucose oxydation by *Str. faecalis* under the action of 4.0% solution of NaCl was inhibited to 93.5%. Also it is seen, that in connection to the different substrates, the degree of inhibition of the oxydative property of the cells in the presence of NaCl is different. The action of NaCl upon the oxydative property of the cells of *Str. faecalis* is strongest with the use as substrates of lactic and ascorbic acids. The oxydation of lactic and ascorbic acids has been inhibited to almost 100% in comparison to the control with adding practically the lowest concentration of NaCl (1.8%). Lowest inhibitory action by the salt is exhibited upon the oxydation of glucose. Same concentration of NaCl inhibits the respiration of cells of *Str. faecalis* when as a substrate is used glucose and this only to 15.1% in comparison to the control.

The results in table 2 show, that the degree of oxydative property inhibition of *Str. faecalis* cells, by NaCl in the logarithmic and stationary phases of evolution is different. Strongest inhibitory action the salt exhibits in the logarithmic phase while in the stationary one it is lowered considerably during the evolution of the enterococci. These data prove that the young growing microorganisms which are in the active logarithmic phase are considerably more sensitive to the inhibitory action of NaCl, while with their age this sensibility decreases.

Our results are analogical with the data obtained by other authors (4) about the inhibitory property of the micella from strain *Actinomyces spheroides* in the logarithmic and stationary phases of evolution.

Influence of NaCl on oxygen absorbtion
mm³/mg/h bt he cells of *Str.faecalis* in
the logarithmic and stationary phases of
evolution.

Table 2

Concentrations of NaCl in %		Logarithmic phase on the 6th h.		Stationary phase on the 16th h.	
		Quantity of absorbed O ₂ mm ³ /mg/h.	Inhibition of respira tion in %	Quantity of absorbed O ₂ mm ³ /mg/h.	Inhibition of respira tion in %
Control		85.25	0.00	17.94	0.00
Test	1.8%	72.34	15.12	17.32	3.47
"	2.2%	67.57	20.74	16.42	8.48
"	2.5%	63.44	25.58	16.11	10.21
"	2.8%	53.89	36.79	15.58	13.18
"	3.0%	50.18	41.14	14.82	17.41
"	3.2%	48.14	43.53	14.47	19.32
"	3.5%	43.98	48.41	14.14	21.18
"	3.8%	25.62	69.95	11.92	33.53
"	4.0%	6.03	93.51	8.08	54.98

Conclusions.

1. In the concentrations of NaCl applied in the preservation and processing of meat and meat products, they exhibit an inhibitory action upon the respiratory activity of *Str.faecalis*.

2. With the augmentation of the concentration of NaCl, the quantity of the absorbed O₂ mm³/h decreases, and with 4.0% solution reaches to 93.51% inhibition of the respiration of 6 hours old culture of *Str.faecalis*.

3. With different substrates, NaCl in quantities corresponding to its content in meat products, inhibits the oxydative property of *Str.faecalis* in different degrees, while it is exhibited the strongest with lactic and ascorbic acids, and weaker with glucose.

4. The sensitiveness of *Str.faecalis* to the inhibitory action

of NaCl, in concentration used in the meat industry, depends on the age of the culture and is higher with the young growing cells in the beginning of the logarithmic stage and weakens in the stationary phase.

5. The inhibitory action of the used in meat processing concentration of NaCl upon the respiration activity of *Str. faecalis* has an important role in preservation, processing and storing of meat and meat products.

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