THE EFFECT OF CURING SALT CONCENTRATION ON THE MICROBIOLOGICAL AND ORGANOLEPTIC STABILITY OF BACON

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SUMMARY

The effect of curing salts concentration /$NaNO_2$ - 50,100,200 ppm and NaCl - 2,3,4 %/ and of packaging method on the outgrowth of indigenous microflora of bacon /sweet, Wiltshire style/ was studied. It was found, that $NaNO_2$ and NaCl in concentrations within examined limits significantly inhibited of microflora of bacon. Nitrites were found to be more potent bacteriostatic agent, than NaCl and their action was noticeable through the whole period of storage though their content decreased permanently. Even the highest concentrations of salts /$NaNO_2$ - 200 ppm, NaCl-4%/ did not inhibited outgrowth of microflora in unpacked bacon sufficiently. Only joint action of curing salts and vacuum produced satisfactory bacteriostatic effect. The microbiological and organoleptic stability of vacuum packed bacon after storage time was good even at the lowest concentrations of curing salts / $NaNO_2$ - 50 ppm and NaCl - 2 %/.

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INTRODUCTION

Recently FAO/WHO introduced on the list of cancerogenic substances in foodstuffs volatile nitrosoamines. Secondary and tertiary amines can react in cured meat and meat products to form cancerogenic nitrosoamines /4,9/. Taking this into consideration, in order to reduce human health hazard, International Agency for Cancer Research /IARC/ has suggested a reduction nitrates and nitrites levels allowed at present in curing practice /8/.

In commercial practice a possibility of decreasing nitrite level is limited to minimum concentration required to form a product of desirable colour and specific flavour /6,11,13/. Moreover curing salts play an important role in inhibiting outgrowth of Cl. botulinum and indigenous microbes influencing stability of product /1,2,3,5,6,15/. They also are known to decrease the thermal resistance of microorganisms /7,10,14/.

According to various authors levels of curing salts required for above effects to occur are related to formulation of product, levels of microbial contamination, processing conditions, packaging techniques and storage conditions. For example, it was found that nitrite in concentrations 15 - 60 ppm exert slight bacteriostatic effect in vacuum packed bacon but in concentrations 120 - 170 ppm delay outgrowth of microflora for 4 - 5 weeks /6/.

This work constitutes a part of research programme undertaken in our Institute to examine possibility of reducing nitrite level without adverse effect on microbiological and organoleptic stability of bacon.

EXPERIMENTAL

Two experiments were performed.

In the first experiment an effect of $NaNO_2$ in concentration 50, 100,200 ppm/ and NaCl in meat /in concentration 2,3,4 %/ on microflora outgrowth was examined.

In the second experiment an influence of packaging technique and method of curing process /sweet and Wiltshire style/ on stability of product were examined.

Materials. In the first experiment chilled loins were used and in the second skinless bellies.

Curing. Meat was pumped with two kinds of brine. Half of samples were injected with brine containing: NaCl, $NaNO_2$, poliphosphates, sugar, ascorbate and protein hydrolizate and the other half of samples were injected with plain brine containing NaCl and $NaNO_2$ only. The samples were cured at 5°C for 48 - 72 hrs. Cured loins and bellies were sliced into portion 3 - 4 cm thikness. Half of slices was vacuum packed in "Nastolam" bags and the other half was left unpacked. All samples were stored at 5°C for 3 - 4 weeks. Samples for examination were taken before curing, after curing and after 3,7,14 and 21 days of storage.

Methods. The microbiological examination included: total play counting and of detemmination enterococci, mould and yeast number. In the chemical examination we determined: NaCl, $NaNO_2$ and water content.

General acceptance of samples, their colour and odour were evalueted organoleptically.

Relationship between curing salt concentration and growth of microflora of bacon was calculated by the variance analysis.

RESULTS AND DISCUSSION

The calculated values F distribution illustrating statistical significance of curing salt concentration effect /$NaNO_2$ - 50, 100,200 ppm and NaCl - 2,3,4 % / on the growth of indigenous microflora during curing and storage of bacon is presented on table 1.

Table 1

kind of bacon	group of microorganisms	curing and storage time	$NaNO_2$	NaCl	NaCl x $NaNO_2$
sweet bacon unpacked	total count	$95,1^{xx}$	$3,9^{x}$	1,0	1,0
	enterococci	$77,9^{xx}$	2,4	1,8	1,0
	moulds § yeasts	$156,9^{xx}$	2,5		1,0
sweet bacon vacuum packed	total count	$348,2^{xx}$	$23,6^{xx}$	$15,0^{xx}$	2,4
	enterococci	$326,5^{xx}$	$6,3^{x}$	$4,0^{x}$	1,0
	moulds § yeasts	$125,9^{xx}$	$10,8^{xx}$	1,0	1,0
Wiltshire style vacuum packed bacon	total count	$202,7^{xx}$	$6,7^{xx}$	$5,0^{xx}$	1,0
	enterococci	$384,4^{xx}$	$15,0^{xx}$	2,4	1,0
	moulds § yeasts	$36,4^{xx}$	1,0	1,0	1,0

Obtained results show that the level of microflora contamination is related first of all to the time of storage.The inhibition of microflora outgrowth by $NaNO_2$ concentration in the range 50 -200 ppm is significant for both unpacked and vacuum packed bacon,although the latter is usually more distinct.

The inhibitory action of NaCl in concentration 2 - 4 % was obserwed only in vacuum packed bacon.

Most resistant to curing salts were moulds and yeast.Their growth was suppressed only by $NaNO_2$ in sweet vacuum packed bacon.

Synergetic action of $NaNO_2$ and NaCl was not confirmed in our experiments conditions.

Bacteriostatic action of $NaNO_2$ was noticable already after curing and lasted to the end of storage,though the concentration of $NaNO_2$ in meat was decreased by 44 % of added amount after 3 days curing and by more than 90 % after 21 days of storage.Thease results are given in table 2 and illustrated on fig.1.

Table 2

Initial $NaNO_2$ content ppm	after curing	after 3 days storage	after 7 days storage	after 14 days storage	after 21 days storage
200	112	92	64	35	19
100	55	41	26	17	7
50	28	23	18	8	2

The above data confirm the findings of other workers that bacteriostatic action of $NaNO_2$ is induced not only on the wya of direct contact but also by indirect effect of nitrite - meat reaktion

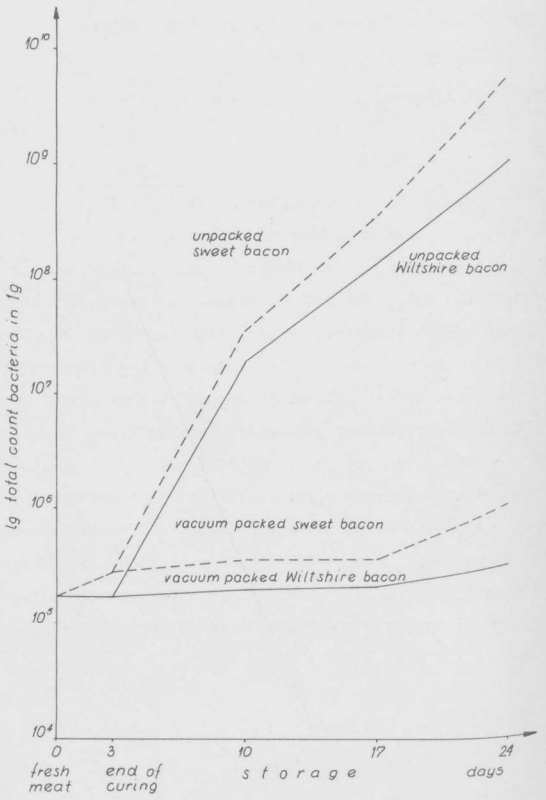

Fig 1. The effect of curing method and packaging technigue on the growth of microflora in bacon

products / Perigo factor /1,6,12/.Hence,a degree of ihibitory action of nitrites is determined by their initial concentration in meat.

Organoleptic evaluation did not show any differences in colour, odour and general acceptance of vacuum packed bacon with all used concentrations of $NaNO_2$.The quality of this bacon was satisfactory. However,unpacked bacon containing the lowest concentration of $NaNO_2$ - 50 ppm,immediately after curing showed discoloured spots, which disappeared during subsequent storage.

The germination of microflora in unpacked bacon was very intensive at all concentrations of curing salts.The level of the bacon contamination was:after curing 10^5per g,after 7 days storage 10^7/g, after 14 days storage 10^8/g and after 21 days 10^9-10^{10}/g./fig.1/. The spoilage of this bacon was observed accordingly at similar sequence.The first signs of spoilage were noticed by organoleptic panel already after 7 to 10 storage days.During following days of storage a development of slime,of off-odour and green-gray discolouration were observed.It was also noticed,that above mentioned changes were appearing 1 - 2 days earlier in sweet bacon than in Wiltshire style bacon / fig.2/.After 21 days all samples of unpacked bacon were spoiled.

On the other hand,bacon processed in identical conditions but packed under vacuum in "Nastolam" bags was of good microbiological and organoleptic quality.

The results of performed examinations show that even the highest concentration of $NaNO_2$ and NaCl added do not delayed a outgrowth of indigenous microflora during chill storage of unpacked bacon, in sufficient degree.

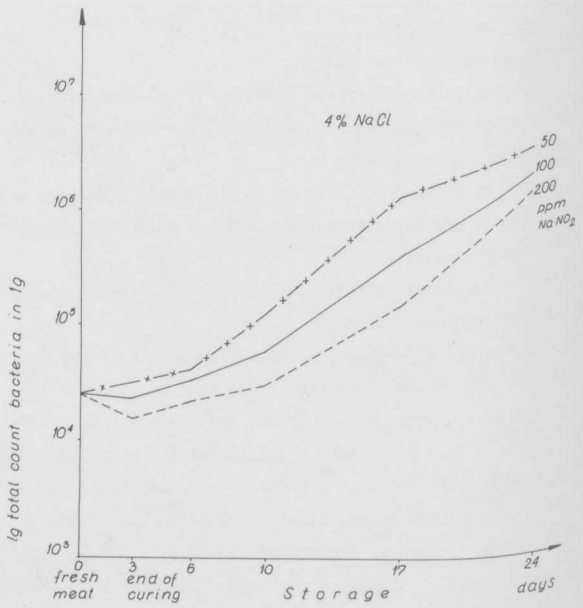

Fig 2. The effect of nitrite concentration on the growth of microflora in bacon

The presented results allow to drawn following conclusions:

Sweet and Wiltshire style bacon - unpacked.

The examined concentrations of curing salts do not delay saficiently the outgrowth of indigeneus microflora during curing and storage time of bacon.In this case the lowearing of salt concentration is not advisable.

Sweet and Wiltshire style - vacuum packed bacon.

In this case the more effective action of examined salt concentration and bacteriostatic effect of the vacuum itself inhibited significantly the outgrowth o microflora and therefore a reduction of nitrite level can be considered.

REFERENCES

1.Collins D.L. et al.1974,J.Food Sci.,39,607

2.Duncan C.L. and Foster E.M.,1968,Appl.Microbiol.,16,406

3.Dinczew D.,1973,Proc.19th Europ.Meet.of Res.Workers,Paris

4.Fazio T. et al.,1973,J.Ass.Off.Anal.Chem. 56,419

5.Gardner G.A.,1971,J.Appl.Bact. 34,645

6.Herring H.K.,1973,Proc.19th Europ.Meet.of Res.Workers,Paris

7.Ingram M. and Roberts T.A.,1971,J.Food Technol. 6,21

8.IARC,1972,Lyon,N-nitrosocoumpounds analysis and formation

9.Möhler K. and Mayrhofer O.L.,1968,Z.Lebensmitt.-Untersuch. und Forsch. 135,313

10.Nordin H.R. et al.,1973,Proc.19thEurop.Meet.of Res.Workers,

11.Ockerman H.W. et al.,1973,Proc.19th Europ.Meet.of Res.Workers

12.Perigo I.A. et al.,1969,J.Food Technol. 2,317

13.Roesler H. et al.,1972, Fleischwirt. 9,1084

14.Stoychev M. and Djajewa G.,1971,17th Europ.Meet.of Res.Workers, Bristol

15.Tonge R.J.,1964,J.Appl.Bacteriol. 27,252.