REDUCTION OF WASTE WATER CONTAMINATION BY SALTING OF CASINGS IN ACID-SALT SOLUTIONS

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INTRODUCTION

The waste waters in meat industry are usually very contaminated by proteins fats and salts. Fats and proteins can successfully and relativ simply be separated by adequate primary(mechanical) and secondary (biological) waste water treatments. However,the dissolved salts are hardly to remove from waste water, so it is very important to apply salting and curing procedures, after which the waste waters contain the lowest possible salt concentration.

One of the greatest salt contaminants of waste waters in meat industry is the department for salting of casings. The second great contaminant is the waste salt solution ,obtained by regeneration of ion exchanger (for water softening). In our judgement there is a possibility for significant reduction of waste water contamination by salt, if the natural casings are salted by wet procedure (instead of present dry procedure), with regeneration and re-use of salt solutions as well as by use of waste salt solution,obtained by regeneration of ion exchanger. Nevertheless in the literature we have found no data upon effects of different parameters by wet procedure on mechanical and technological properties of casings and their shelf-life,i.e. bacteriological contamination.Therefore the detailed laboratory investigations were carried out in order to determine the influence of some essential factors in wet salting of casings on their properties.

MATERIAL AND METHODS

The cleaned pig small intestines were used for investigations. They were kept under static conditions (without stirring) in salt solutions of different composition and for a different period. The ratio casings/ salt solution was 1 : 2. In casings the bacteriological contamination, % H_2O, %NaCl and mechanical properties were analyzed in definite periods and on the end of salting process.In some salt solutions the

the changes of pH value and the concentrations of Ca^{++} and Mg^{++} ions were determined.

In the first series the casings were kept in two salt solutions. The first solution contained, in addition to different salt (NaCl) quantities, the different quantities of lactic acid. The dipping time ranged from 0 to 120 min.The second solution was saturated with salt, only the dipping time was varying from 2 to 15 days. The casings were kept in first solution at room temperature of 5°C to 8°C (in department for casing salting).

In the second series the experimental casings were kept during the whole experiment (4 - 6 days) at 5°C - 8°C in saturated salt solution containing lactic acid (pH = cca 2). The salt solution contained different quantities of Ca^{++} and Mg^{++} ions,in order to determine how their concentrations affect the salting process and the quality of salted casings.

The chemical and bacteriological analysis were carried out by usual methods and procedures. The mesurements of chemical propeties (tensile strenght and stretching) were carried out on 5 samples, 15 mm width, using INSTRON 4301 (tongue distance 15 mm, extension speed 200 mm/min) Five measurement were carried out (n = 5).

RESULTS

In the first series was varied:

- Dipping time in both two salt solutions,
- Salt quantities in the first solution,
- Kind of acid and its concentration (pH) in the first solution.

The influence of dipping time in first (acid.salt) solution on chemical composition and bacteriological contamination is showen in table 1. Table 2. presents the results of measurements of tensile strenght depending on different dipping time in the first solution.It is obvious that in the first solution the significant changes occur in the first 30 minutes, so that it is not reasonable to keep the casings more than 60 minutes in this solution.

Table 1.

Dipping time in 1.sol. min.	$\%H_2O$	%NaCl	Total bact. count in 1 g
After treatment in 1. solution			
0	87,3	0	20.000
30	80,9	9,0	2.000
60	78,9	10,0	1.000
120	79,0	10,4	-
After treatment in 2. solution			
30	70,3	21,0	28.000
60	67,1	23,4	3.000
120	66,9	23,1	700

Table 2.

Dipp.time in 1. sol. ,min	Tensile strenght N/15mm vertical	transversal
0	21,8	4,95
30	24,5	6,45
60	23,3	6,15
120	31,1	5,25

The influence of dipping time on composition and mechanical properties of casings salted in saturated salt solution on mechanical properties of casings can be seen in tables3.and 4.

Table 3.

Dipping time in 2.sol. days	$\%H_2O$	%NaCl	Total bact. count in 1 g
2	70,9	17,0	5.000
4	67,1	23,4	3.000
8	68,2	23,1	3.000
15	66,6	24,7	1.000

Table 4.

Dipping time in 2.sol days	Tensile strenght,N/15mm vertical	transversal
2	20,6	4,35
4	23,3	6,15
8	22,8	7,35
15	24,0	6,10

As it is obvious from table 3. there is no significant change in composition of casings after 4 days of keeping them in saturated salt solution. The mechanical properties showed also no significant changes after 4 days, so it can be concluded that the optimal dipping time for the second solution should be between 4 and 8 days.

In the first solution the great influence on bacteriological contamination and mechanical properties has the quantity of lactic acid (pH),whereas it has less influence on chemical composition of salted casings,which can be seen from the results presented in tables 5. and 6.

Table 5.

Lactic acid in 1.sol,%	pH before treatment	pH after treatment	pH change during the treatment
0,2	3,2	4,8	+1,6
0,5	2,7	3,8	+1,1
2	2,2	3,0	+0,8
4	1,8	2,5	+0,7

Table 6.

Lactic acid in 1.sol.,%	Chem.comp.of salted casings $\%H_2O$	%NaCl	Total bact. count in 1 g
0,2	72,0	20,6	*35.000
0,5	71,5	19,8	*4.000
2	66,8	21,0	-
4	67,0	20,4	-

* presence of gas-producing bacteria

Table 5. shows pH values of the first solution before and after dipping (60 minutes) with different quantities of added lactic acid. It is obvious that it is necessery to add at least 2 % lactic acid into the first solution (pH app. 2), to ensure the satisfactory dehydratation and to prevent the bacterial growth in casings.

Table 7.

Lactic acid in 1.sol,%	Tensile strenght,N/15mm vertical	transversal
0,2	20,0	3,75
0,5	25,7	6,00
2	30,9	7,05
4	29,7	6,75

Table 7. shows that it is necessery also to reach the desirable mechanical properties of salted casings.

The results of investigation upon influence of kind of added acid and salt concentration into the first solution on composition and mechanical properties of salted casings will not be presented because of limited space.Only the conclusions from this investigations will be given. If the lactic acid is replaced with the same concentration of acetic acid, there is no significant differences in composition and properties of salted casings. Regarding the salt quantities in the first (acid-salt) solution it can be concluded that the qualuty of salted casings is better with higher concentration of salt in solution, and the concentration should not be lower than 15%, in order to obtain the casings of a good quality.

In the second series of experiments the influence of Ca^{++} and Mg^{++} concentrations in salt solution on composition and mechanical properties of salted casings was investigated.Such investigation were necessery for estimation of possibility to use the waste salt solution,obtained by regeneration of ion exchanger,which contains higher quantities of Ca^{++} and Mg^{++} ions, in wet salting of casings. For investigation three acid-salt solutions with different concentrations of Ca^{++} and Mg^{++} were taken.

Table 8.

Exper.sol. Nr.	Conc.of Ca^{++}, g/dm³ start	end	Conc. of Mg^{++}, g/dm³ start	end
1	0,96	0,248	0,086	0,051
2	1,24	0,280	5,7	3,4
3	1,32	0,284	10,0	6,1

Table 8. shows the results of chemical analysis of experimental solutions before and after salting of casings.The concentration of Na^{+} amounted in all three solutions to app. 100 g/dm³ with no significant variations (saturated solution). The concentrations of Ca^{++} and Mg^{++} were significantly lowered during the contact with casings in all three solutions, so it can be concluded that Ca^{++} and Mg^{++} are better bounding in casings in comparison to Na^{++}.

From the results presented in table 9 it can be seen that with the increased concentration of Ca^{++} and Mg^{++} ions the quantity of salt bounded in salted casings is also higher.At the same time the dehydratation of casings is higher too,which is favorable for the shelf life and quality of casings In all experiments the salted casings were sterile,because the pH value at the beginning of the experiment was app. 2 and at the end of salting process app. 3.To a certain extent the increased concentrations of Ca^{++} and Mg^{++} ions in salt solution have influence on mechanical properties of salted casings,which can be seen in

table 10.

Table 9 .

Sample of casing from sol.Nr.	%H_2O	%NaCl	Total bact. count in 1 g
1	69,3	20,1	-
2	67,6	21,8	-
3	67,7	22,4	-

Table 10.

Sample of casing from sol Nr.	Mechanical properties Tensile strenght N/15 mm		Stretching %	
	vert.	trans.	vert.	trans.
1	14,1	5,26	51,1	74,7
2	13,8	4,82	44,5	84,4
3	15,8	4,76	39,7	81,1

The tensile strenght in transversal direction seems to be decreased with higher concentrations of Ca^{++} and Mg^{++} ions in salt solution.The differences noticed in our experiment are probably not significant, so the suggestion is to repeat the experiment.

With the increasing of quantities of Ca^{++} and Mg^{++} in salt solution the vertical stretching of salted casings is lower and the transversal one is higher.

CONCLUSIONS

On the basis of the obtained results the following conclusions can be made:

1. By salting of pig small intestines in acid-salt solution under the optimal conditions,the casings of good mechanical properties which are at the same time practically sterile can be produced.With increased concentrations of salt and acid in solution the dehydratation process is accelerated,the bacteriological contamination is reduced and the mechanical properties of casings improved.

2. The presence of increased Ca^{++} and Mg^{++} concentrations in salt solution indicate no negative influenceon mechanical properties and shelf life of salted casings.

3. During the salting using the acid -salt solutions the certain quantity of organic matters is extracted from casings, which demands the development of procedure for their floculation and separation after several application of salt solution.