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MICROBIOLOGICAL PROBLEMS OF MECHANICALLY DEBONED PORK MEAT PRODUCTION AND PROCESSING

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SUMMARY

It was found that the process of mechanical removing of meat from bones, influenced deterioration of the microbiological quality of the obtained MDM. A steady increase in the number of microorganisms took place during storage at 2 - 4°C.

NaCl /2%/ restrained the development of coliforms. Curing with the addition of nitrite not lower than 0,01% in relation to the weight of the sample, caused a partial inhibition of bacterial growth in comparison to that in the MDM without any preservatives and with the addition of a smaller dose of nitrite.

Freezing and storage at -18°C of cured and not cured MDM , caused a nearly 10-fold decrease of the total number of aerobic microorganisms.

An addition of MDM to hamburgers increased their contamination, but heating to 80°C improved their microbiological state. It was concluded that MDM should not be stored under refrigeration, but can be used in cooked products.

INTRODUCTION

Mechanically deboned meat /MDM/ represents a potential source of high quality protein in a world of food shortages. It can be produced from whole carcasses, or from partially cleaned bones obtained in hand boning operations. Most mechanically deboned meat is produced by comercially available machines, which force whole , broken, or coarsely ground bones with meat attached against the screened or slotted surface of the deboner.

Mechanically deboned meat is now approved for use in many countries and is being used in sausages and other ground and processed meat items.

However , further studies are needed to determine whether the use of MDM poses a health hazard. Mechanically deboned meat produced by the extrusion process is very finely minced and is an ideal medium for microbial growth. In addition, pH values of MDM are higher than those of hand boned meat , because of incorporation of marrow into the meat.

Microbiological quality of deboned meat can be a problem if the bones of carcass parts used are not kept cold and deboned immediately upon removal from the carcass /Ostovar et.al.,1971/. When strict limitation in time, temperature and storage conditions are followed, microbiologica quality of mechanically deboned meat compares very favorably with that of ha boned meat /Goldstrand 1975, Field et.al 1974/.

However, in our country there are proble with microbiological quality of mechanica lly deboned meat. Hence, further studies were needed to determine whether the use of MDM poses a health hazard.

The purpose of this study was to evaluat the microbiological quality of MDM durin storage under refrigeration, during free zing, with an addition of NaCl and $NaNO_2$ and the microbiological quality of hamburgers with a 15% addition of MDM.

MATERIALS AND METHODS

Pork backbones obtained from carcasses after partition and cutting, were passed through a Seffelaar-Looyen separator /type MRS/, at the Żerań Meat Plant in Warsaw.

The microbiological state was determined in hand recovered meat just after deboning and in mechanically deboned meat. Then MDM was salted /2% NaCl/ and cured with various curing mixtures : 2% NaCl + 0,08% ascorbic acid + /0,004 - 0,01/% $NaNO_2$. MDM without any additions , after salting and after curing was stored at the temperature of 2 - 4°C for 1, 2, 3, 4 and 6 days. MDM after 2 hours of curing and MDM without any additions was freezed and stored at -18°C for 4 and 8 weeks.

Model meat blends were made of pork meat /70%/, pork fat /28%/ and sodium chlorid /2%/. In the experiment 15% of pork meat was replaced by MDM. Meat blends were manufactured in the shape of hamburgers, then freezed and stored at the temperatu of -18°C for 4, 8 and 12 weeks. The micro biological state was determined in hamburgers with and without MDM before and after storage. Analysis in frozen hamburgers were done before and after heat tre atment /80°C for 10 minutes/.

Microbiological analysis were done according to the Polish Standard Method /Polish Norms 1973/ :
- aerobic plate count in 1 g
- presumptive test for coliforms /with Brilliant Green Lactose Bile Broth/
- presumptive test for enterococci.

The pH value was measured with a pH-meter N-512 type.

The average experimental results were sta tistically analyzed by the means of the t-Student test.

RESULTS AND DISCUSSION

The pH value of the MDM immediately after deboning was higher than before this process /analyzed in hand deboned meat/ /table 1/. An pH increase of MDM when com pared with hand boned meat is a result

Figure 1. Diagram of experiments.

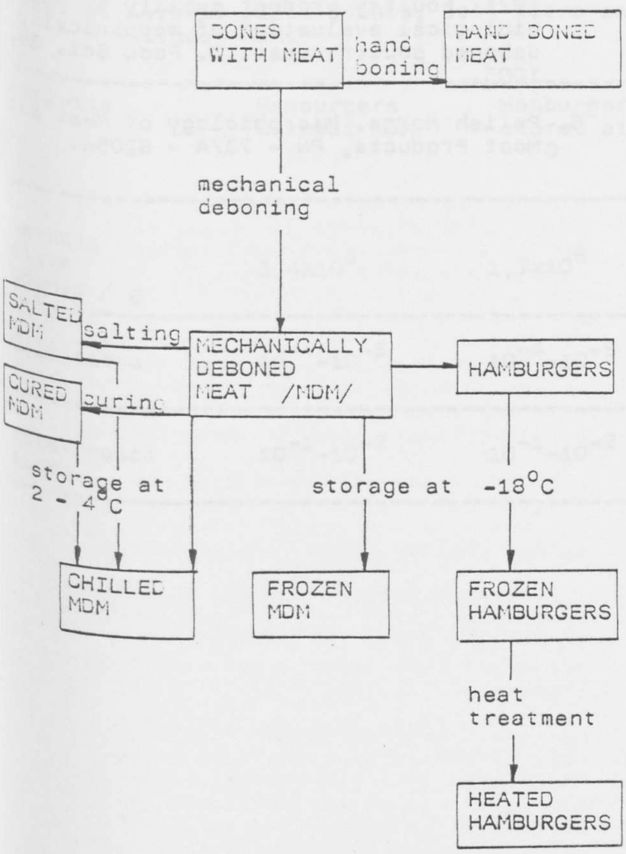
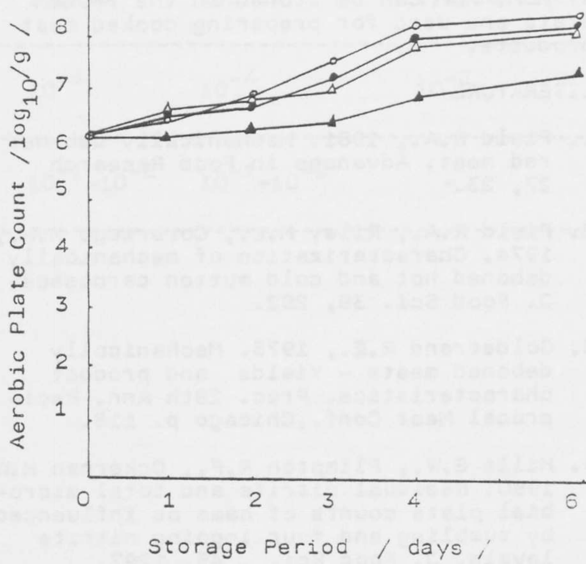


Figure 2. Effect of salting and curing on aerobic plate counts of MDM stored at 2 - 4°C.

o without additions
• salted
△ cured with 0,006% $NaNO_2$
▲ cured with 0,01 % $NaNO_2$



of the incorporation of red marrow, which has a pH ranging from 6,8 to 7,4. Arasu /Field 1981/ has shown a linear increase in pH with an increase in the marrow-to-muscle ratio up to mixtures that are 50% red marrow and 50% muscle.

The process of mechanical deboning influenced deterioration of microbiological quality of the obtained meat mass /table 1/. There was nearly a 10-fold increase in the total number of aerobic microorganisms, a higher contamination with coliforms and enterococci.

Refrigeration for 6 days caused a steady increase of pH. The increase in the number of microorganisms took place at the same time, too. /table 1/. The presence and growth of microorganisms in MDM during storage under refrigeration proves the existence of psychrotrophic microflora of this product which is mentioned in literature /Ostovar et.al.,1971/.

Addition of NaCl did not significantly influence the development of microorganisms. Only the inhibition of coliforms was found. /fig.2/. It is known from literature that E.coli in comparison to other aerobic microorganisms, is very sensitive to NaCl.

Also curing with the addition of 0,006% $NaNO_2$ in relation to the weight of the sample, did not restrain the development of microflora during storage under refrigeration. It is known from literature that even a smaller dose of nitrite decrease the number of microorganisms in other products, for example in smoked ham /Mills et.al. 1980/. In the case of mechanically deboned meat not less than 0,01% of nitrite must be added to cause a partial inhibition of bacterial growth, in comparison to that in the MDM without any preservatives. A smaller number of microorganisms is corelated with the lower pH value in comparison to that in the not cured MDM. It was concluded that MDM can be stored under refrigeration for five days if it is cured with the addition not lower than 0,01% of $NaNO_2$ in relation to the weight of the meat.

Freezing and storage in the frozen state /t=-18°C/ of cured and not cured MDM, caused a nearly 10-fold decrease of the total number of aerobic microorganisms /table 2/,The influence of curing substances on restraining the development of bacteria , was not observed.

An addition of mechanically deboned meat to hamburgers increased their contamination There was nearly 10-fold increase in the total number of aerobic microorganisms, a higher contamination with coliforms and enterococci /table 3/. Storage in the frozen state of hamburgers did not cause a statistically significant decrease of the total number of microorganisms. Only the enterococci titre was higher which proves lower contamination with these bacteria.

Heating of hamburgers to 80°C and keeping at this temperature for 10 minutes, improved their microbiological state /table 3/. Total plate count was very low, coli titre was higher and there were no enterococci in samples.

It was concluded that mechanically deboned pork meat because of its microbiological state , should not be stored under refrigeration if it was not cured. Curing must be done with the addition of not less then 0,01% of $NaNO_2$, in relation to the weight of MDM. MDM can be stored in the frozen state and used for preparing cooked meat products.

LITERATURE

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Table 1. Effect of the deboning process and storage under refrigeration on aerobic plate counts, coli titre,enterococci titre and pH-value of MDM.

Analysis	Hand deboned meat	MDM stored under refrigeration / days / 0	2	4	6
pH	5,8	6,2	6,3	6,4	6,5
Aerobic plate counts/1 g	$1,9\times10^5$	$1,6\times10^6$	$3,3\times10^6$	$1,1\times10^8$	$1,8\times10^8$
Coli titre	$10^{-2}-10^{-3}$	$10^{-4}-10^{-5}$	$10^{-4}-10^{-5}$	10^{-5}	10^{-6}
Enterococci titre	10^{-2}	$10^{-2}-10^{-3}$	$10^{-2}-10^{-3}$	10^{-3}	10^{-3}

Table 2. Effect of storage at -18^oC on aerobic plate counts / 1 g in cured and not cured MDM.

Days of storage	Not cured MDM	MDM cured with the addition of $NaNO_2$ 0,004%	0,006%	0,008%
0	$3,1\times10^6$	$3,2\times10^6$	$3,1\times10^6$	$3,0\times10^6$
2	$3,3\times10^6$	$2,6\times10^6$	$2,4\times10^6$	$1,0\times10^6$
28	$2,4\times10^5$	$2,3\times10^5$	$2,3\times10^5$	$1,6\times10^5$
56	$1,6\times10^5$	$1,7\times10^5$	$1,7\times10^5$	$1,5\times10^5$

Table 3. Aerobic plate counts, coli titre and enterococci titre in hamburgers with and without MDM.

Analysis	Hamburgers without MDM	Hamburgers with MDM stored at $-18^{\circ}C$ / days / 0	28	56	after heating
Aerobic plate counts / g	$3,4 \times 10^{5}$	$1,7 \times 10^{6}$	$1,1 \times 10^{6}$	$1,1 \times 10^{6}$	$1,1 \times 10^{4}$
Coli titre	$10^{-4}-10^{-5}$	$10^{-4}-10^{-5}$	10^{-4}	10^{-4}	10^{-2}
Enterococci titre	$10^{-1}-10^{-2}$	$10^{-1}-10^{-2}$	$10^{-1}-10^{-2}$	$10^{-1}-10^{-2}$	-