SURVIVAL OF SALMONELLA IN THE PROCESS OF LIVEX PRODUCTION AND ITS BEHAVIOUR ON THE LIVEX SURFACE

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SUMMARY

During the production of a fresh fodder livex modified with whey, a reduction of Salmonella number takes place at the level which ensures safe feeding of animals. When Salmonella gets onto the surface of a fresh brown livex basal, modified with whey, it starts to grow even at a temperature of 6°C. Hence the livex has to be protected against the contamination with these bacteria, and stored at the temperature not higher than 4°C.

INTRODUCTION

The production of any kind of fresh livex of any animal blood or its fraction is carried out by means of a biotechnological method |2|.

The name "livex" refers to many types and varieties of hardened products of animal blood or its fraction. Depending on the initial raw material used, the following livex types are distinguished: brown livex made of blood, white livex of blood plasma, and black livex of condensed blood cells. Each of these livex types can occur in the form of a basal livex and a modified one, whereas the modification is performed only with regard to its biological value. A basal livex can be obtained from each of the mentioned basic raw materials by means of adding the hardening substances. To obtain a modified livex it is necessary, beside the addition of a hardener, to introduce either of such chosen subsidiary liquid substances as, e.g. whey, buttermilk, vegetable or meat decoction, or a solid one, such as bran, dried grass, vegetable pomace, or meat shreds. All these components, or other, are introduced into the still liquid blood or its fraction, where they are firmly enclosed in a natural fibrin grid of the modified clot.

The created modified clot, together with hardeners, and with or without the addition of subsidiary substances, constitutes a raw livex. Its consistence is that of a solid, firm jelly, which, after cutting into pieces, is being thrown into water of about 80°C and then scalded for a period of time necessary to obtain a coagulation of the whole protein volume and a proper pasteurization effect. The scalding process results in a considerable reduction of the number of bacteria. After taking out of water, dripping off and cooling down, the obtained livex becomes a fresh livex, 1 g of which contains 10-100 bacterial cells. The pieces of the fresh livex have a firm and solid consistence.

Fresh livexes - basal white and brown modified with whey - have a better keeping quality than fresh meat in the same storing conditions. After 3 weeks of storing at a temperature of 0°C, 1 g of these livexes contains 10^4-10^5 bacteria, only.

The high level of the reduction of the number of bacteria during scalding gave rise to standardization of this process using Salmonella as a model microorganism. The aim was to determine such parameters of thermal processing which would lead to the reduction of the number of bacteria to the level 7D. Assuming that it is possible to obtain such lethal pasteurization effect, some tests have also been performed as to the possibility of Salmonella growth on the surface of a fresh brown livex, with the assumption that its presence on the livex results from a post-productional pollution.

A. SURVIVAL OF SALMONELLA IN THE PROCESS OF LIVEX PRODUCTION

The tests were made on a warm-resistant Salmonella enteritidis PCM 843. The bacteria were revived from a lyophilizate and then passed three times through a TSB broth. The obtained culture was centrifuged. The sediment was washed three times in a Ringer liquid. The washed sediment was suspended in a pasteurized whey which was then mixed with a stabilized porcine blood. The blood-whey mixture in a liquid state was introduced into heparine capillary tubes. After the raw livex has been formed, the tubes were heated up in order to determine survival curves. The determination of Salmonella enteritidis number in the raw livex was carried out on BGA without regeneration, whereas in the fresh livex (after warming it up) it was done with 1 h regeneration in a TSB broth at 37°C. The formulae of survival curves were determined by means of the least square method, on the basis of which the D values for particular temperatures were found. On the basis of the above results it was possible to determine the reflection curve TDT at the level 7D, represented by the expression $y = -0.25x + 15.485$. From the determined reflection curve TDT the values of $z = 4.00$ and $F_{65.6} = 0.122$ (Fig.1) were calculated. In order to calculate the lethal effectiveness of the pasteurization process, the pieces of livex (1 kg mass and 65 mm diameter) have been scalded in water at 80°C. The scalding process lasted 40 min. Temperature changes in the thermal centre of the pieces during the scalding and air-cooling are shown in Fig.2. The lethal effectiveness of the tested process of the livex scalding by $z=4.00$ is $F_{65.6} = 65.1$, whereas for the heating phase it is 4.114 and for the cooling phase it is 61.054. The value $F_{65.6} = 65.1$ is several times higher than that required to obtain the reduction to the level 7D for the tested Salmonella enteritidis the same applies to the most warm-resistant Salmonella senftenberg 775W |1|.

Taking this into account, the process of livex scalding can be considered as the pasteurization fully ensuring the safety of feeding farm animals.

B. BEHAVIOUR OF SALMONELLA ON THE LIVEX SURFACE

To select bacteria tribes for tests, 25 lyophilized Salmonellae were revived and their growth rate was determined at 6°C and 4°C. For further tests the following tribes were selected:

Salmonella typhimurium KHPZ 5
Salmonella tenneessee KHPZ 9
Salmonella typhimurium PCM 1047

which showed the best growth rate at 6°C. Before each test, the tribes were sieved three times through TSB every 24 hrs, and the last culture was washed thrice in a physiological fluid, the amount of which was equal to the initial volume of the material. The bacteria suspension was diluted and its density was determined. From the respective dilution one drop, containing ca. 10^5 Salmonella, was brought onto the flat surface of the livex of porcine blood, and another drop, containing 10^6 Salmonella, was put into 9ml of TSB. The tests were made using a fresh basal brown livex FBBL, and fresh brown livex modified with whey FWBL. The fresh livexes contaminated with Salmonella were kept at 6°C, 10°C, and 22°C, and the number of bacteria was checked every 24 hrs. The samples of the contaminated surface were collected for tests and homogenized in the nine times greater amount of physiological fluid. Farther qualitative and quantitative tests were carried out according to conventional methods. The determination of the changes of Salmonella number in

TSB was a means of control of its behavior in similar conditions on the surface of fresh livexes.

The behaviour of the three Salmonella types on each fresh livex is similar. Hence only the type Salmonella typhimurium PCM 1047 is discussed here.

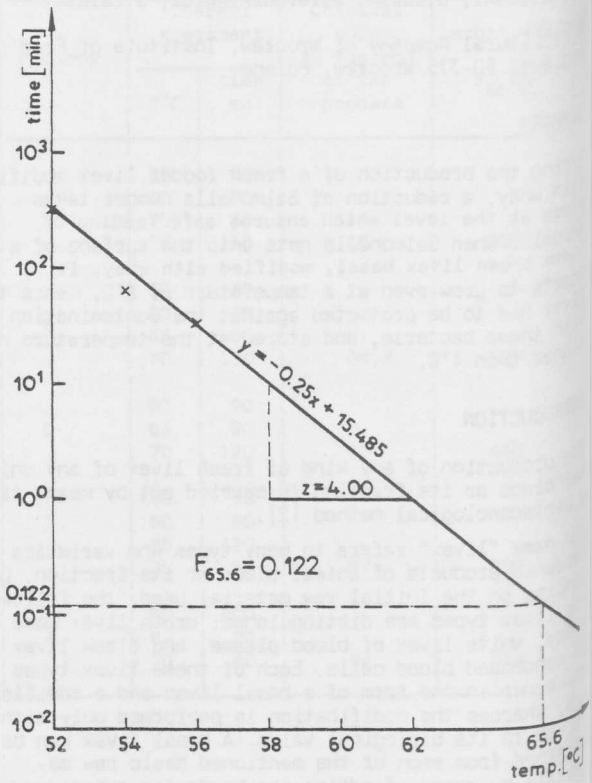
When FBBL is stored at 6°C and 10°C, the reduction of Salmonella number is observed during the first 24 hrs of storing, whereas at 22°C the number of these bacteria remains the same (Fig.3). During farther storage the growth of Salmonella takes place at all tested temperatures, this growth being the slowest at 6°C.

The behaviour of Salmonella on the surface of FWBL (Fig.4) is similar to that on the FBBL surface, although the reduction of the bacteria number during storage at 6°C and 10°C is less pronounced. As it results from Fig.3 and Fig.4, no reduction of Salmonella took place on the TSB broth at either of the temperatures tested, and the growth dynamics at each temperature was similar to that observed on the surface of both fresh livex types. Hence the Salmonella population reached its highest value on the surface of fresh livexes with a delay resulting from the Salmonella behaviour during the first 24 hrs of storage.

The reduction of Salmonella number on the surface of fresh livexes stored at 6°C and 10°C can be probably attributed to the livex reaction. It is possible that this effect is caused by the defence mechanisms present in the blood used for the livex production. Although part of these mechanisms become inactivated in the process of scalding, the activity of the rest may still be preserved. The greater reduction of Salmonella number on the surface of FBBL may result from the fact that the latter contains ca.25% more blood than FWBL.

The results of the research on the behaviour of Salmonella on the surface of both types of fresh livexes is indicative of the necessity of protecting these livexes against contamination with those bacteria and of storing them at temperatures not higher than 4°C.

Fig. 1. TDT curve of Salmonella enteritidis at the 7D level



LITERATURE

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2. Zaleski S.J., L.Kumor, B.Ławik, A.Malicki, S.Szubińska, R.Tereszkiewicz. XXX European Meeting of Meat Research Workers, Bristol, Great Britain, August 1984.

Fig. 2. Lethal effectiveness of the pasteurization process for a fresh whey brown livex FWBL

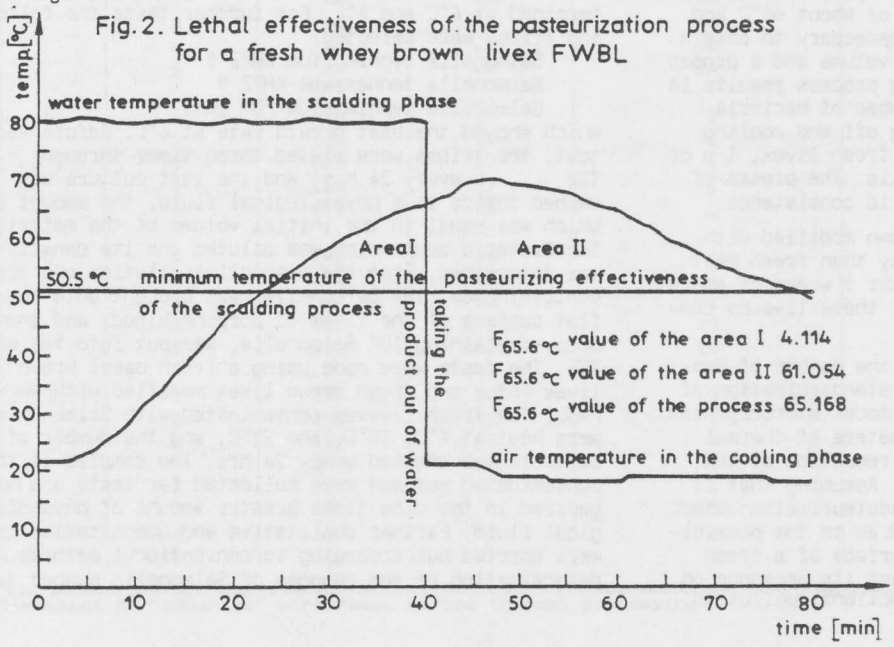

Fig. 3. Salmonella typhimurium PCM 1047 behaviour on the surface of a fresh basal brown livex (FBBL)

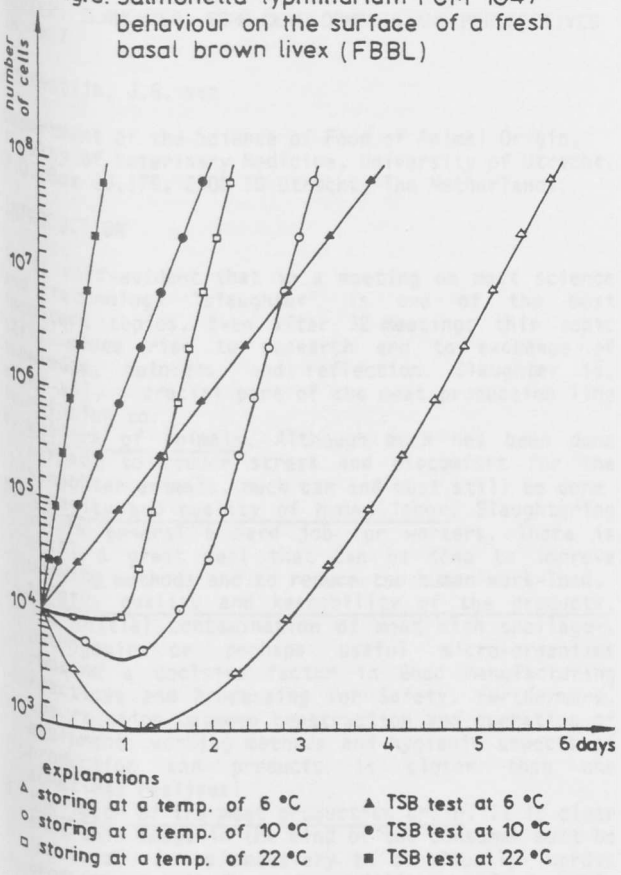

Fig. 4. Salmonella typhimurium PCM 1047 behaviour on the surface of a fresh whey brown livex (FWBL)