IX^th CONFERENCE OF EUROPEAN MEAT RESEARCH WORKERS
Budapest, September 4-11, 1963

Microbiological Control in Processing Prepackaged Meats

by

Peter Zeuthen, Veterinarian
The Danish Meat Research Institute, Roskilde, Denmark.

The problem of controlling the microbiological activities in prepackaged meats is very important, as the major part of the consumers and the retailers are of the conviction that vacuumpacked meats should be handled as preserved meats. This erroneous belief has contributed to a certain distrust in these products, namely when consumers have opened packages and found them spoiled at an earlier date than stated on the label. In most cases the reason for the early spoilage is to be sought in careless handling somewhere during the distribution from producer to consumer, or the latter may have left the package at too high a temperature. It is known that although most producers nowadays have printed on the wrappings that the products must be kept in a cool place - a maximum of 5°C is often stated - a lot of wholesalers, retailers and consumers ignore this caution and then complain because of the amazingly short shelf life of the products and in most cases the blame for the rapid spoilage is put on the producer, even when the product was processed with utmost care and left the factory in a perfectly fresh state.

The problem of how to produce prepackaged meats with a minimum of problems with the keeping quality may be solved by (1) advising correct handling of the products from the time of production to consumption, (2) stating an expiring date for the specific product if kept at a maximum of a stated temperature, and - finally - (3) producingproducts with lower initial contamination through a thorough microbiological control. This paper deals with methods to produce products contaminated as little as possible, with special reference to sliced bacon. The methods described here may of course be useful in other productions.

ooo

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

271.

Everybody familiar with the meat industry knows how important it is to keep machines, fixtures and fittings clean. Whenever it is possible, stainless steel should be chosen for all surfaces which come in contact with the products. This does not mean that wood or other softer materials are impossible to clean, but as these surfaces get worn they crack, and offer excellent possibilities for bacterial growth unless special precautions are taken. In plants producing sliced bacon, the slicing- and packing line is usually constructed completely of stainless steel, and this offers good conditions for cleaning. The weak points here seem to be utensils associated with but not directly belonging to the line. For one thing, if the slices which are divided by hand in order to make the individual portions up to correct weight are not handled at least as careful as the slices on the line, much damage is done. In some cases these slices are cut up on a rather contaminated wooden board and often remain on this for a long time. To avoid a wooden plank when cutting up these slices, scissors should be used, and the person who cuts the slices should be provided with a pile of dishes for distribution to the weighing stations, so re-use of dishes between cleaning is restricted.

The following table illustrates at how low a level the contamination can be kept on a stainless steel slicing line for bacon, if the staff is properly instructed and well trained. The table also shows where the contamination accumulates during working hours, and the level of this contamination gives an impression of the numbers of bacteria on the raw materials being sliced. The method employed for measuring the contamination on the equipment is described by Hansen (1962). As a comparison, column 3 shows the condition in a plant not so well organized as the first one. This plant was able to keep the contamination down by applying a heavy smoke to the middles. This gave a considerable loss in weight of the middles.

ooo

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

272.

Table 1

Number of bacteria per sq.cm. on different parts of equipment in slicing plants. Standard deviation of the method: 0.15-0.30 log cycle.

	Plant No.1		Plant No. 2
	Before work	After 6 hrs. work	Before work
Slicing knife	13 (1.11)[x]	2500 (3,40)	25 (1,40)
Bacon press	below 10 (below 1,0)	18 (1,26)	40 (1,60)
Dish for distribution of weighing slices	12 (1,08)	430 (2,63)	- -
Plastic conveyor touching the meat	12 (1,08)	83 (1,92)	40 (1,60)
Rubber conveyor not touching the meat	below 19 (below 1,0)	below 10 (below 1,0)	13 (1,11)
Weighing station	14 (1,15)	160 (2,20)	31 (1,99)
Cart for transport of the middles	12 (1,08)	180 (2,25)	2600 (3,42)
Cutting board, wood			800 (2,90)

x) log. counts

The table indicates that it is feasible to start with nearly sterile equipment. Further, it is evident that the parts which get most contaminated are those touching every slice, e.g. the slicing knife. Also it demonstrates that only the parts touching the meat get contaminated, see for instance the plastic conveyor versus the rubber conveyor. Finally the table shows that when part of the equipment is unattended, which was the case with the cart used in the second plant, it may become a source of pollution.

ooo

273

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 246

Meat has to be cooled to about -2°C before slicing. This takes place in a chilling room where the whole chunks of meat usually are hung on hooks. Very often these chilling rooms are shared with other departments, and so are the hooks.

The hooks are frequently a source of contamination of the products because nobody seems to be responsible for the cleaning of these. To find out just how important this source of contamination is we have used a modification of the method described by Herschdoerfer (1961).

The principle of it is that pollution of the meat is made visible in a pattern which replicates the contamination. Slices of meat directly from the slicing line are put into sterile Petri-dishes. After 16-24 hours of incubation at 30°C a 0,5% aquous solution of 5-phenyl-2-(p-iodophenyl)-3-(p-nitrophenyl) tetrazolium chloride is sprayed over the slice which is then incubated for another 30 minutes. The microcolonies which develop during the first incubation now appear as purple spots on the meat and the topography of them often tell the story how the contamination originally took place. This method is best when examining cured meats since especially gram positive bacteria are able to reduce the tetrazolium dye.

We found, when examining a production of sliced bacon how the natural surfaces of the middles contaminated freshly cut surfaces, and also that the top slice of each portion was more heavily contaminated because of a more frequent handling. Finally we found slices with holes from the hook on which the whole middle had been hung. These slices were almost sterile except round the edges of the hole plus a "fall-out" area to one of the sides. This contaminated area originated from the slicing operation, because the knife became contaminated each time it cut through the edges of the hole, and distributed the bacteria on the new meat surface.

ooo

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

Another source of contamination originates from the hands of the staff working in the plant.

This source, of course, not only gives possibility for contamination with microorganisms originally transferred to the hands from anything the hands have been touching - including the meat - but it also gives a risk of infecting the meat with pathogens, especially food-poisoning staphylococci. To reduce this risk the staff is usually provided with hand disinfectants, of which a whole range is available.

We have examined some of the types, including hand disinfectants containing quarternary ammonium compounds and hexachlorophene, and we have compared the effect on the bacterial numbers on hands. We also tested the effect of common hand soap. The method we used is not very exact, but on repitition we got rather precise results.

The test was carried out in the following way: the persons involved had visually "clean" hands, but they had not been washed the last hour before the test. Sampling was done using contact method. The persons involved rubbed their palms and fingers gently on the surface of pre-poured agar plates, one plate for each hand. Immediately afterwards the persons washed their hands in the disinfectants to be tested and new samples were taken as described above every fifteen minutes for one hour and a half. For the test we used Chapman agar plates which was incubated. Suspect colonies were examined in an attempt to find out whether the decrease in the total number of bacteria on the hands was accompanied by a similar decrease in the numbers of staphylococci. The results were evaluated by assuming that any person would rub the hands off in the same way each time. Therefore, the plates from the first test, where a person rubbed his hands off before he used the disinfectant, were reckoned as

this particular person's normal amount of contamination, and the average of all these first time plates was used as a standard. All other counts were related to this standard as the percent of contamination of the hands as compared to an untreated hand. The participants - persons from our laboratory - were allowed to work during the test, but they were not allowed to wash their hands nor to wet them. Initial tests had shown that all the participants occasionally were harbouring coagulase positive staphylococci on their hands.

Figure 1 shows the results we got when testing the various disinfectants. The curve representing the effect of hand soap, which was nil, also expresses the inaccuracy of the method. However, it will easily be seen that we found 4 types of disinfectants, which could be distinguished from each other.

Type 1: This type represented by curve "B", a disinfectant not only inactive, but also harmful, because it seems to collect any contamination the hands may touch during the time of testing. Disinfectant "B" is a cream containing quarternary ammonium compound.

Type 2: Represented by curves "F" and "G". "G" is solid hand soap and "F" a liquid hand soap containing hexachlorophene. It will be seen that the effect of this - if there was any - disappeared within the first quarter of an hour after use. It also shows, as expected, that soap has no lasting bactericidal effect.

Type 3: Disinfectants "A" and "E", both containing quarternary ammonium compounds. The effect of this type is unquestionable within the first hour after use. In an investigation we carried out, we found that 85-90% of the staff washed their hands within this time.

Type 4: Both these disinfectants, "C" and "D", contained hexachlorophene, and it is seen that these two disinfectants definitely are superior to any of the other types, both with regard to an immediate decrease of the bacterial numbers and the time during which an effect was present.

ooo

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

Disinfectants "A" and "D" were selected for further tests to find out whether re-use of a disinfectant would give a further decrease in the bacterial numbers. The participants in this test were allowed to do normal work, but could only use the disinfectants to be tested for washing throughout the day. At intervals the hands were tested for contamination, and it was found that if "A" was used, the contamination was reduced by a third, whereas the use of "D" gave two thirds of reduction. The Participants only used the disinfectants during working hours, and on testing them for several consecutive days we found roughly the same contamination every morning, in other words we were unable to prove any effect beyond the day the disinfectant was used, an effect which many producers of hand disinfectants claim.

The effect of disinfectants on the total number of coagulase positive staphylococci was also tested. These tests revealed no evidence that the effect of the disinfectants was selective towards staphylococci, a decrease in the total numbers of bacteria was followed by a similar decrease in the number of staphylococci.

Table 2. The effect on staphylococci on hands through using hand disinfectants.

Disinfectant used	Percent of staphylococci on plates from staphylococcal carriers.
"A"	8,1%
"D"	2,5%
Hand soap	12,1%

ooo

The percentages are still related to the percent of "normal" total contamination (100 percent).

These tests were carried out on a laboratory-basis, whereas the following investigation was undertaken in a slicing plant.

The results from our laboratory tests were roughly confirmed here. At that time we were mainly concerned with the effect of hand disinfectants on Staphylococcus aureus.

Figure 2 shows the effect of a wash with hand soap followed by a disinfection of the hands using a hand lotion containing a quarternary a ammonium compound. At that time we were unaware of the fact, that soap apparently had a tendency to inactivate this sort of disinfectant, and the figure gives a good picture of the quick build-up of contamination if an ineffective disinfectant is used.

The following day the same persons used a disinfectant identical with the earlier described disinfectant "A". The effect of this is shown in figure 3.

Figure 4 shows the result of an investigation carried out in the same plant about 6 months later.

Figure 4 confirms the laboratory test where we found no effect of hand soap and an effect during the first hour after a disinfection using disinfectant "A".

Often when in vivo tests are carried out with hand disinfectants the effect is measured just after the use of the disinfectant, or the effect of several minutes' wash is measured. This is realistic when testing disinfectants for surgeons, but it would, indeed, be a very difficult tast to supervise that the staff of a whole factory wash their hands for several minutes every time. What the meat industry wants to know is the effect of a certain disinfectant when it is used as an ordinary cleansing medium by the staff.

...

278

During processing of prepacked meats the bacterial counts usually increase, However, it is very often possible to prevent this by scalding the product in a boiling brine containing 20% NaCl and 0.2% $NaNO_2$. The purpose of adding nitrite is to prevent discoloration as discussed below. If the meat has already been cured, the scalding may be carried out in boiling tap water, since the meat colour is fixated in this sort of meat.

Even though freshly slaughtered pigs are occasionally severely contaminated, a scalding for 10 seconds suffices an almost complete sterilisation of middles.(see table 3). It is worth noticing that though the rind side of middles is normally more contaminated than the meat side before a scalding, it seems to be reverse afterwards as shown in table 3. The figures are averages of determinations from 6 middles.

Table 3. The effect of scalding on the rind side versus the meat side of fresh middles.

	Numbers of bacteria per sq. cm.	
	Before scalding	After scalding
Rind side	126.000	below 10
Meat side	35.500	45

Fresh meat is slightly discoloured when it is scalded, though the nitrite does protect the meat colour, to some extent, but this slight discoloration is immaterial in the case of sliced meats, as the scalded edges of the slices are so small in area that it isn't noticable. Taste testing panels at the Danish Meat Research

Institute judging sliced bacon which was scalded during processing were unable to detect any discoloration due to scalding.

In the earlier mentioned plant No. 1, where we examined the contamination on the equipment, we also tried to scald some middles. Usually this plant washes the middles in hot water after draining, and we tried to improve the effect of washing by substituting it with a scalding. As will be seen in table 4, we managed to reduce the baterial numbers by a decade at the time of slicing, in this way.

Table 4. The effect of scalding versus washing middles.

	No. of bacteria per sq.cm. measured on the meat side
Middles after draining	8000
Washed middles after smoking just before slicing	430
Scalded middles after smoking just before slicing	55

The described improvements in sanitation have made it possible to improve the keeping quality of the products considerably. Where the initial numbers of bacteria in prepackaged meats earlier could be counted in thousands or tens of thousands, we have now in several cases been able to start with initial bacterial numbers at the order of hundreds or even tens per gram of prepackaged, sliced meats.

PZ/HG

...

References

Hansen, N.-H. (1962), J.appl.Bact. 25 (1), p. 46-53.

Bradshaw, N.J., Dyett, E.J., and Herschdoerfer, S.M. (1961), J.Sci.Food Agric., 12, April, p. 341-344.

ooo

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

Figure 1. The influence of hand disinfectants on the bacterial numbers on hands.

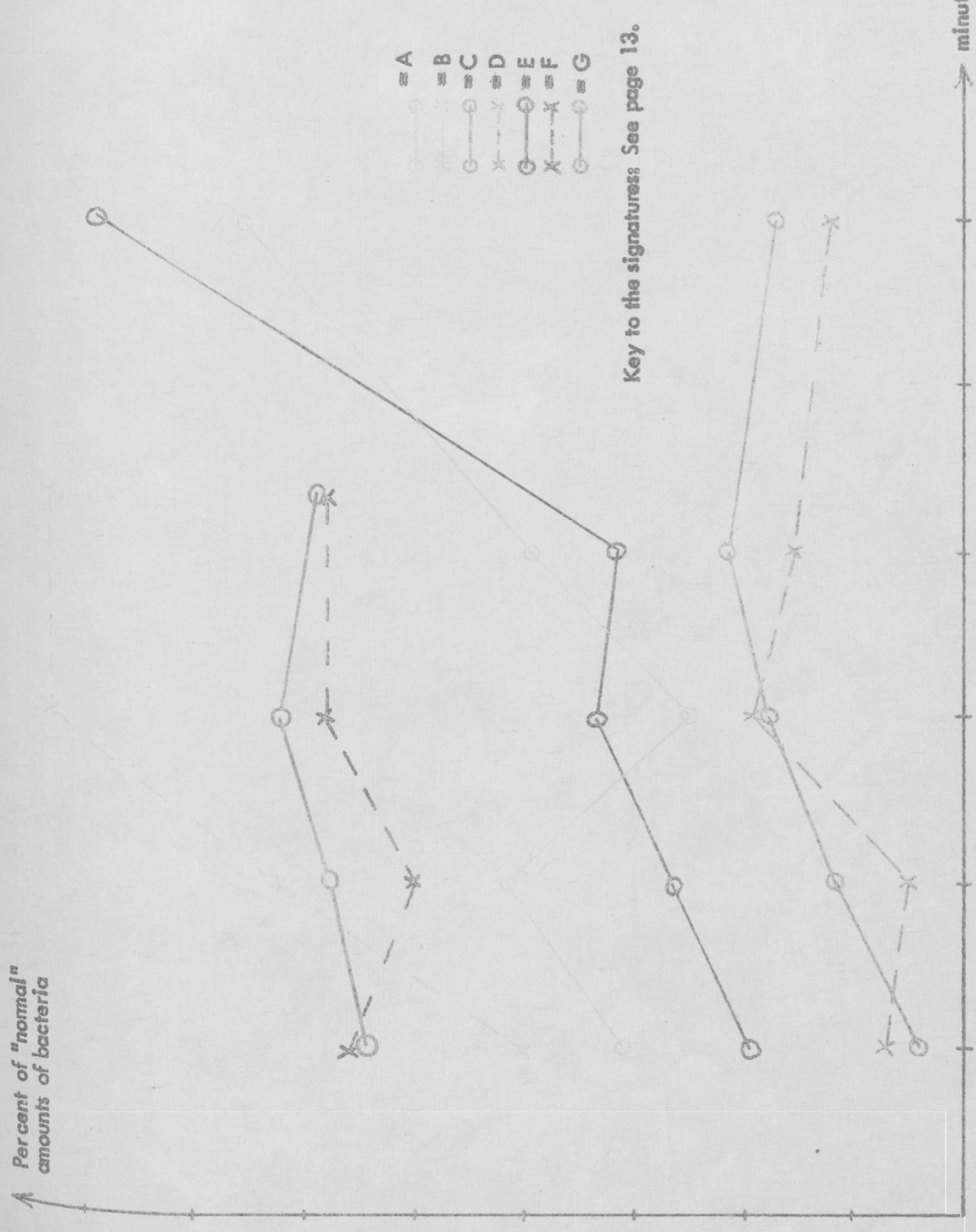


Figure 1. Key to the signatures.

Hand disinfectant	Type of cleaning agent and disinfection	Disinfectant used
	A detergent lotion	both q.a.c., 2% and 0,2%
	B solid hand soap, cream	q.a.c. 3%
	C solid hand soap, cream	hexachlorophene 3%
	D liquid detergent	hexachlorophene 3%
	E solid hand soap, lotion	q.a.c. 2%
	F liquid soap	hexachlorophene 3%
	G solid hand soap	

SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

Figure 2. The effect of a bad or a complete inactive hand disinfectant.

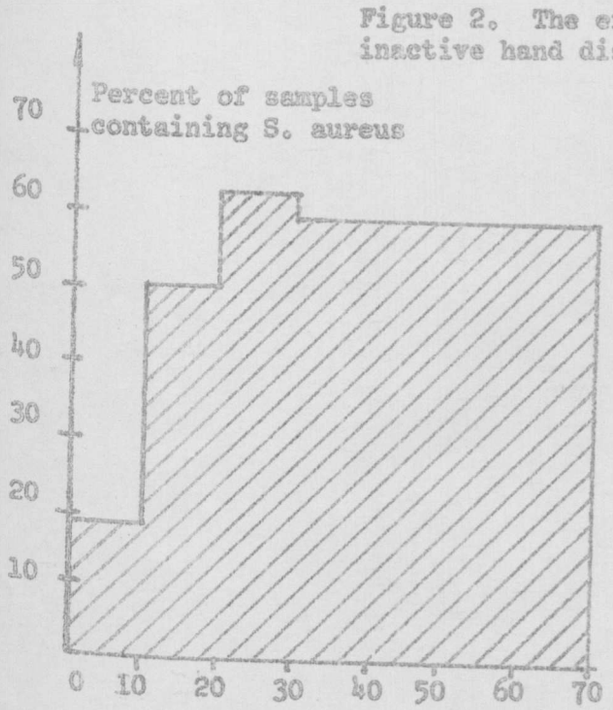


Figure 3. The effect of using disinfectant "A".

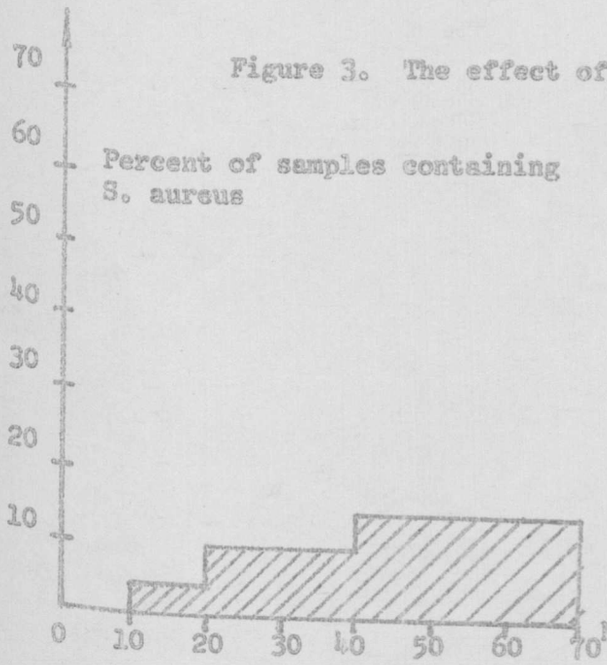
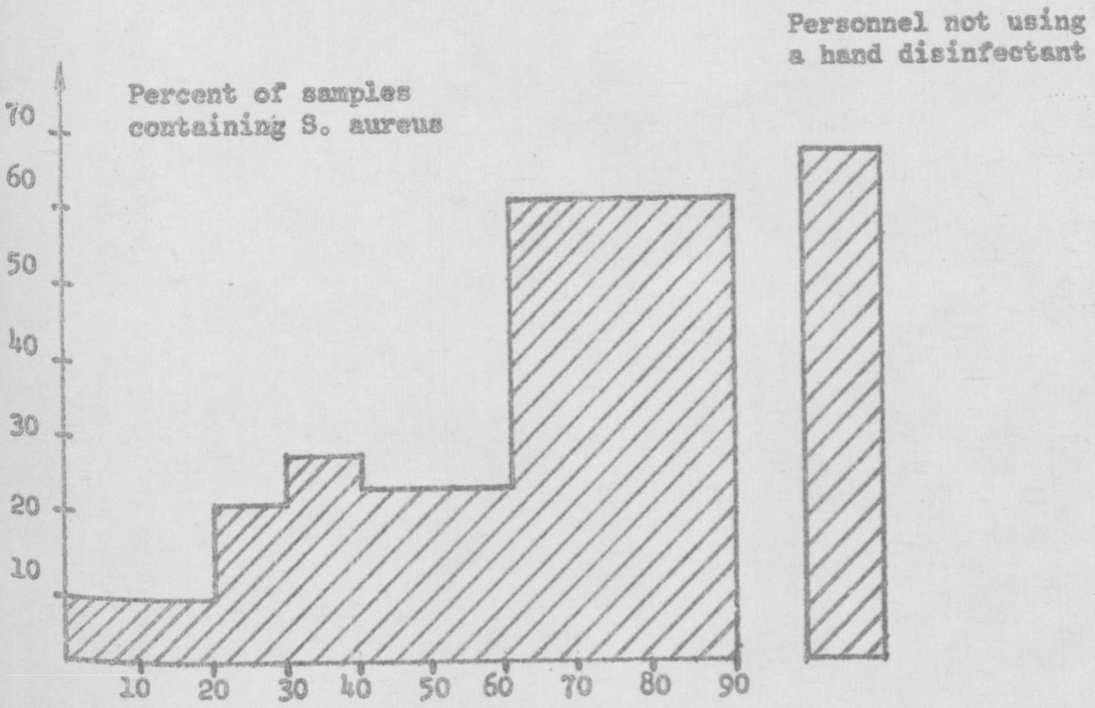


Figure 4. The effect of using disinfectant "A". The investigation was carried out 6 months after the test shown in figure 3.



SLAGTERIERNES FORSKNINGSINSTITUT
25. juli 1963

FÆRDIGPAKKEDE KØDVARER
Manuskript nr. 248

Microbiological Control in Processing Prepackaged Meats

by

Peter Zeuthen, Veterinarian
The Danish Meat Research Institute, Roskilde, Denmark

Summary

The paper deals with some of the microbiological methods employed in order to improve the sanitary standard in processing prepackaged meats.

The importance of using stainless steel for the slicing line is stressed. Also it is shown how important it is to give the equipment associated with, but not directly belonging to the slicing line as much attention as the slicing line itself.

In Denmark we have used a method described by Herschdoerfer by means of which the topography of the contamination on the meat slices can be demonstrated. The purpose of this is to use the pattern of contamination as a help to find the source of it. In this way, for instance, the influence of contaminated meat hooks on the distribution of microorganisms on the slices was found.

Investigations carried out at The Danish Meat Research Institute show, that the use of a good hand disinfectant will reduce the bacterial numbers on the hands and keep it low for at least one hour. The reduction amounts to about two thirds of "normal" contamination, if the disinfection is carried out by applying the same amount of mechanical work as one would do in ordinary handwashing. The occurrance of staphylococci seems to be reduced at the same rate as the total flora.

Finally the paper deals with the effect of scalding raw materials in a boiling brine containing 20% NaCl and 0.2% $NaNO_2$, and it is shown that regular blocks of meat become nearly sterile in this way. However scalding of pork middles seems to be more effective on the rind side than the meat side.