

# INFLUENCE OF STONE-LIKE DEPOSITS ON THE STERILIZABILITY OF FARM DAIRY EQUIPMENT

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## SUMMARY

The sterilization efficiency of hypochlorites, chlorhexidines, iodophors, organic ammonium chlorides and hot water was examined both before and after the removal of stone-like deposits from dairy equipment.

Although the efficiency of chemical sterilization was markedly reduced by the presence of stone-like deposits, it was possible to heat-sterilize such equipment satisfactorily.

## I. INTRODUCTION

Investigations of the cleaning efficiency of a number of chemical compounds used with waters of various degrees of hardness have been reported by the author (Major 1962). The sterilizability of dairy equipment just prior to re-use 7-14 hr after cleaning was also examined and the results are reported here.

## II. PROCEDURE

The experiments were performed on commercial dairy farms. The farmer was trained in the desired methods of cleaning and sterilizing. The cleaning methods used were those detailed by Major (1956a) for recirculation cleaning and Major (1960) for rinse cleaning.

Heat sterilization was obtained by increasing the temperature of the cleaning solution to 190°F and that of the final rinse water to 200°F, both temperatures being taken as the solution was about to enter the milking machine. The remainder of the dairy utensils were cleaned normally and then rinsed with water at not less than 200°F, using 1 gal for a vat,  $\frac{1}{2}$  gal for a cooler and 1 gal for a can and lid. No premilking rinse was used on those occasions on which the efficiency of heat sterilization was assessed.

Chemical sterilization was obtained by drawing the appropriate chemical solution through the milking machine and then using it to rinse the remaining utensils. A contact killing time of 20 min was allowed to elapse between this rinsing and the commencement of milking. To avoid the sterilizing effect of heat during cleaning, the temperature of the cleansing rinse was reduced to 160°F, and the final rinse temperature was reduced to 180°F while the efficiency of chemical sterilization was being investigated. To ensure that the sterility of the equipment was such that milk of satisfactory bacteriological quality could

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be produced at the commencement of each sub-experiment, the equipment was sterilized on each occasion the farmer changed over from one form of chemical sterilization to another. On these occasions the rubberware was removed from the milking machine, enclosed in a hessian bag, and immersed in boiling water for 20 min. The plant was then reassembled, and 2 gal water at a temperature of 200°F was drawn through each unit. The remaining utensils were then rinsed with water at 200°F in the manner outlined for heat sterilization. The efficiency of this treatment was then assessed bacteriologically before the new form of chemical sterilization was commenced.

The degree of sterility of the equipment was assessed at weekly intervals for continuous periods of not less than three months and not greater than 12 months.

After assessing the efficiency of heat and of the various chemical sterilants in the presence of stone, the equipment was treated for stone removal by the method developed by Major (1956*b*) and the series repeated in the absence of stone. On some farms there was a tendency for stone to build up on the equipment, and on such farms several destoning treatments were performed in order to keep stone to a very low level.

The method of assessing sterilizing efficiency was as follows:

(a) The udder and teats of each of the test cows were prepared by washing, chemically sterilizing and drying. The hands of the experimenter were scrubbed and chemically sterilized.

(b) A composite 1 pt sample of milk was then aseptically hand-drawn into a sterile Erlenmeyer flask from each of the first series of cows. A subsample was retained for analysis.

(c) The remainder of this milk was then used to rinse a sterilized can. The can was rotated for five revolutions in a horizontal position, and then inverted quickly five times. The milk was then poured into the can lid for subsampling.

(d) During machine-milking of the test cows a sample was taken of the first milk leaving the releaser.

(e) The remainder of the milk from the test cows was allowed to collect in the milk vat. This milk was then rinsed over the inside surface of the vat. A sample of the first milk leaving the vat was then collected.

(f) The milk from the test cows then flowed over the cooler into a prepared can. A sample was collected of the first milk leaving the cooler.

(g) Milking of the herd proceeded until the first can was filled. At this stage a sample of milk was obtained from the can. A further sample of the milk leaving the releaser was then collected.

**TABLE 1**  
**COMPARISON OF STERILANT EFFICIENCY ON EQUIPMENT WITH AND WITHOUT STONE-LIKE DEPOSITS**  
**Percentage of Trials in which the Plate Counts were in various Groupings**

| Sterilant   | Heat  |    |     | Hypochlorites |    |     | Chlorhexidines |    |     | Iodophors |    |     | Organic Ammonium Chloride |    |     |
|---|---|----|-----|---------------|----|-----|----------------|----|-----|-----------|----|-----|---------------------------|----|-----|
|   | I   | II | III | I             | II | III | I              | II | III | I         | II | III | I                         | II | III |
|   | BEFORE "STONE" WAS REMOVED FROM THE EQUIPMENT |    |     |               |    |     |                |    |     |           |    |     |                           |    |     |
| 1. Aseptically drawn direct from cow  | 100   | 0  | 0   | 100           | 0  | 0   | 100            | 0  | 0   | 100       | 0  | 0   | 100                       | 0  | 0   |
| 2. Rinse of can with sample 1 . . . .   | 98  | 2  | 0   | 60            | 40 | 0   | 83             | 17 | 0   | 78        | 22 | 0   | 62                        | 38 | 0   |
| 3. Leaving releaser at start of milking . .                                     | 95  | 5  | 0   | 12            | 52 | 36  | 22             | 78 | 0   | 10        | 65 | 25  | 13                        | 65 | 22  |
| 4. Cow's milk, first series, rinsed around vat. Sub-sample leaving vat. . . . . | 93  | 7  | 0   | 16            | 20 | 64  | 22             | 78 | 0   | 10        | 78 | 12  | 11                        | 57 | 32  |
| 5. First of milk leaving the cooler . . . .                                     | 93  | 7  | 0   | 12            | 36 | 52  | 22             | 78 | 0   | 11        | 78 | 11  | 9                         | 53 | 38  |
| 6. Sub-sample drawn from the first can of milk filled . . . . .                 | 98  | 2  | 0   | 20            | 46 | 32  | 22             | 78 | 0   | 12        | 76 | 12  | 12                        | 65 | 23  |
| 7. Milk leaving the releaser 30 minutes after the commencement of milking       | 99  | 1  | 0   | 24            | 44 | 32  | 22             | 78 | 0   | 25        | 63 | 12  | 21                        | 66 | 13  |
|   | AFTER "STONE" WAS REMOVED FROM THE EQUIPMENT  |    |     |               |    |     |                |    |     |           |    |     |                           |    |     |
| 1. Aseptically drawn direct from cow  | 100   | 0  | 0   | 100           | 0  | 0   | 100            | 0  | 0   | 100       | 0  | 0   | 100                       | 0  | 0   |
| 2. Rinse of can with sample 1 . . . . .   | 98  | 2  | 0   | 96            | 4  | 0   | 97             | 3  | 0   | 98        | 2  | 0   | 100                       | 0  | 0   |
| 3. Leaving releaser at start of milking . .                                     | 96  | 4  | 0   | 94            | 6  | 0   | 93             | 7  | 0   | 95        | 5  | 0   | 92                        | 8  | 0   |
| 4. Cow's milk, first series, rinsed around vat. Sub-sample leaving vat. . . . . | 95  | 5  | 0   | 95            | 5  | 0   | 92             | 8  | 0   | 94        | 6  | 0   | 92                        | 8  | 0   |
| 5. First of milk leaving the cooler . . . .                                     | 96  | 4  | 0   | 94            | 6  | 0   | 90             | 10 | 0   | 94        | 6  | 0   | 90                        | 10 | 0   |
| 6. Sub-sample drawn from the first can of milk filled                           | 98  | 2  | 0   | 96            | 4  | 0   | 93             | 7  | 0   | 96        | 4  | 0   | 100                       | 0  | 0   |
| 7. Milk leaving the releaser 30 minutes after the commencement of milking       | 100   | 0  | 0   | 97            | 3  | 0   | 94             | 6  | 0   | 97        | 3  | 0   | 100                       | 0  | 0   |
| No. of trials before removal . . . . .  | 368   |    |     | 256           |    |     | 186            |    |     | 147       |    |     | 73                        |    |     |
| No. of trials after stone removal . . . .                                       | 312   |    |     | 352           |    |     | 165            |    |     | 151       |    |     | 85                        |    |     |

\* I—Less than 30,000 colonies per ml.  
 II—31,000 to 500,000 colonies per ml.  
 III—Greater than 500,000 colonies per ml.

The samples were plated on tryptone glucose extract agar and colony counts made after incubation at 30°C for two days, using the methods outlined by the American Public Health Association (1953).

### III. RESULTS

Table 1 summarizes the results obtained by treating farm dairy equipment with heat and with chemical sterilants, both in the presence and in the absence of stone-like deposits on the equipment.

Of the samples obtained from heat-sterilized equipment, 98 per cent. had bacterial counts less than 30,000 colonies per ml, irrespective of whether or not the equipment was coated with stone-like deposits.

When the equipment was sterilized with hypochlorite rinses, only 20 per cent. of the samples from equipment coated with stone had counts less than 30,000 colonies per ml, and 32 per cent. of the counts were in excess of 500,000 colonies per ml. However, when the stone was removed from the equipment, 96 per cent. of the samples had counts less than 30,000 colonies per ml, and none of the samples had counts exceeding 500,000 colonies per ml.

When chlorhexidines were used as sterilants in the presence of stone, only 22 per cent. of the samples had bacterial counts less than 30,000 colonies per ml, whereas after the stone was removed 93 per cent. of the counts were less than this.

With the use of iodophors as sterilants in the presence of stone, only 12 per cent. of the samples gave counts less than 30,000 colonies per ml, compared with 96 per cent. after the stone was removed.

Where the organic ammonium chlorides were used as sterilants in the presence of stone, only 21 per cent. of the counts were below 30,000 colonies per ml, but when the stone-like deposits were removed, 100 per cent. of the counts were below this figure.

It is therefore concluded that, when stone-like deposits are present on dairy equipment, heat is an effective sterilizing agent, whereas the chemical sterilants used in the experiments are markedly less effective. However, when stone-like deposits are removed, both heat and these chemical sterilants effectively sterilize farm dairy utensils.

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