STERILIZATION OF MILKING MACHINE RUBBERWARE

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SUMMARY

Rubberware in good mechanical condition was sterilized satisfactorily with hot water and all of a number of inorganic and organic sterilants tested, but few of the sterilants were effective when the rubberware was in an unsatisfactory condition.

Prolonged immersion in hot water completely inhibited bacterial development whatever the condition of the rubberware. A hot-water rinse was not so effective and its efficacy declined with deterioration in the condition of the rubberware. Heat sterilization did not shorten the effective working life of the rubberware.

The efficacy of caustic soda as a sterilant, which was high with rubberware in good condition, fell off slightly with unsatisfactory rubberware. However, the use of caustic soda tended to prolong the working life of rubberware. Sodium metasilicate was similar to caustic soda.

The efficacy of chlorhexidine, iodophor and organic ammonium chloride solutions was high with good rubberware but declined rapidly as the condition of the rubberware worsened. None of these solutions appeared to erode either rubber or metal surfaces.

Sodium hypochlorite was ineffective as a sterilant even with rubberware in good condition. It eroded the surface of the rubberware, thereby increasing the difficulty of chemical cleaning and sterilizing.

I. INTRODUCTION

Where bacteriological quality of milk is unsatisfactory at the time of production one of the main sources of contamination is the rubber parts of the milking machine (Major 1962*a*). Accordingly assessments were made of the bacteriological efficiency of various treatments of these rubber parts. These experiments were conducted with the co-operation of commercial milk producers.

II. METHODS

The co-operating farmer was provided with the necessary equipment and chemicals, and was trained in the desired experimental procedures. The milking machine was cleaned by the methods described by Major (1956*a*) for recirculation cleaning and Major (1960) for rinse cleaning. Where stone-like deposits were present on the equipment they were removed prior to the commencement of the experiments by the method developed by Major (1956*b*). The mechanical condition of the rubberware was visually determined during each visit to the farm to sample the milk and rated as visually satisfactory, poor, or unsatisfactory.

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In tests with caustic soda, sodium metasilicate and sodium hypochlorite, after removing the cleaned milking-machine cup assembly from the metal downdrop, it was placed, mouth upwards, in a specially designed rack with the end of the rubber milk-line held at the same level as the open ends of the inflations. The rubberware was then filled when the test solution, which was drained off just prior to the subsequent milking, and the equipment replaced on the milking machine just before the herd was milked. After milking, the equipment was cleaned and the rack soaking was repeated. As it was necessary to use claws without an air admission hole, the milking machine was converted from a pipeline-type to a bucket-type and the milk subsequently drawn from the milking machine bucket into the overhead milk-line to permit cooling and filling into cans.

In tests of organic chemicals, the cleaned milking machine rubberware assembly was removed from the metal downdrop and completely immersed in the test solution. During this process care was taken to ensure that the rubberware was completely filled. Just prior to the subsequent milking the test solution was drawn from both the milk space and the air space of the assembly, which was then replaced on the milking machine. After milking, the equipment was cleaned and the teat-cup assemblies and long rubbers were returned to the soaking bath.

Two methods of heat sterilization were investigated—a rinse method and an immersion method. In the rinse method the temperature of the cleaning solution was increased to 190°F and that of the final rinse was increased to 200°F. Both temperatures were taken as the water entered the machine. In the immersion method the assembled teat-cups, claws, short rubber and long rubber were placed in a bag and immersed in boiling water for 20 min. They were then removed, drained, and placed on the milking machine. This method was completed shortly before the commencement of the milking.

The following test solutions were used for each rack soaking:—

(*a*) An inhibited caustic soda stock solution was prepared by dissolving 2 lb caustic soda and 3 oz sodium sulphite in 20 lb soft water. The solution used to fill the rubberware was prepared by adding 16 fl oz of this stock solution to 1 gal soft water.

(*b*) Sodium metasilicate stock solution was prepared by dissolving 4 lb hydrated sodium metasilicate in 20 lb soft water. The solution used to fill the rubberware was prepared by adding 16 fl oz of this stock solution to 1 gal soft water.

(*c*) A stock 10 per cent. solution of sodium hypochlorite was provided together with a measure which facilitated the preparation of a solution containing 100 p.p.m. available chlorine. This solution was used to fill the rubberware.

(*d*) Water drawn from the normal farm supply was also used to fill the rubberware between milkings.

The following test solutions were used for each tub soaking experiment:—

(*a*) The chlorhexidine test solution was prepared by adding to each gallon of water 6 ml of a 7·5% (w/w) solution of chlorhexidine delta gluconate. This gave a concentration of 100 p.p.m. of its active constituent.

(*b*) The iodophor test solution was prepared by adding to each gallon of water 7 ml of a stock solution containing phosphoric acid 15·95 per cent., an iodine complex of nonyl-phenylethers of polyethylene glycol 12·60 per cent., and an iodine complex of polyethoxy polypropoxy ethonal 4·85 per cent. This gave a concentration of 25 p.p.m. of its active constituent.

(*c*) The organic ammonium chloride test solution was prepared by adding to each gallon of water 7 ml of a 10 per cent. solution of benzyl dimethyl ammonium chloride. This gave a concentration of 40 p.p.m. of its active constituent.

The efficiency of rubberware sterilization was assessed by comparing the bacterial content of samples of milk aseptically hand-drawn from test cows with the bacterial content of milk drawn from the same cows through the test rubberware into a laboratory-sterilized milking-machine bucket.

III. RESULTS AND DISCUSSION

The results obtained are summarized in Table 1.

When the hot rinse technique was used to sterilize the milking-machine rubberware, 98 per cent. of the samples of milk produced had plate counts less than 30,000 colonies per ml if the rubberware was visually rated either satisfactory or poor. However, when the rubberware was rated unsatisfactory, only 86 per cent. of the samples had plate counts less than 30,000 colonies per ml. When the immersion method of heat sterilization of the milking-machine rubberware was used, all of the milk samples contained less than 30,000 colonies per ml, irrespective of the visual condition of the rubberware. The effective life of the rubberware was not reduced by heat sterilization.

The caustic soda and the sodium metasilicate rack soak methods of sterilizing milking-machine rubberware gave similar bacteriological results to those obtained by hot rinse sterilization. However, neither the sodium hypochlorite nor the water soak rack methods provided efficient sterilization even when used with rubber of satisfactory visual condition. Sodium hypochlorite in addition eroded the surface of the rubber. Treatment with caustic soda prolonged the effective life of the rubberware.

The tub soak methods using chlorhexidine, iodophor and organic ammonium chloride were efficient only when used with rubber of satisfactory visual condition. None appeared to erode either rubber or metal surfaces.

TABLE 1

STERILIZATION OF MILKING MACHINE RUBBERWARE

Treatment of Rubberware	Visual Condition of Rubberware								
	Satisfactory (405 trials)			Poor (189 trials)			Unsatisfactory (216 trials)		
	Bacteriological Quality of the Milk*								
	I	II	III	I	II	III	I	II	III
Heat—									
Hot rinse	98	2	0	98	2	0	86	14	0
Immersion	100	0	0	100	0	0	100	0	0
Chemical—									
Rack soak—									
Caustic soda	100	0	0	100	0	0	86	14	0
Sodium metasilicate	100	0	0	100	0	0	82	18	0
Sodium hypochlorite	Nil	46	54	Nil	3	97	Nil	1	99
Water	Nil	39	61	Nil	4	96	Nil	0	100
Tub soak—									
Chlorhexidine	93	7	0	63	15	22	22	46	32
Iodophor	96	4	0	71	13	16	17	42	41
Organic ammonium chloride	99	1	0	73	15	12	31	27	42

* I—Percentage of the samples whose plate count was less than 30,000 colonies per ml.
II—Percentage of the samples whose plate count was greater than 30,000 colonies per ml but less than 500,000 colonies per ml.
III—Percentage of the samples whose plate count was greater than 500,000 colonies per ml.

Of all of the methods examined, rack soak sterilization with either caustic soda or sodium metasilicate gave the longest effective working life of the rubberware as measured by the days of use from new to the commencement of surface cracking. The shortest effective working life occurred when hypochlorites were used as sterilants.

REFERENCES

MAJOR, W. C. T. (1956*a*).—Recirculation cleaning of milking machines. *Qd Agric. J.* 82: 481-90.

MAJOR, W. C. T. (1956*b*).—A simple, rapid method for removing scale-like deposits from dairy utensils and milking machines. *Qd Agric. J.* 82:649-52.

MAJOR, W. C. T. (1960).—Cleaning milking machines in Queensland. *Qd Agric. J.* 86:161-8.

MAJOR, W. C. T. (1962).—Importance of milking machine rubberware as a source of bacterial contamination. *Qd J. Agric. Sci.* 19:123-5.

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