

The effect of residues of detergents and detergents-sanitizers on the performance of antibiotic test and the organoleptic quality of milk

U. MERIN and I. ROSENTHAL

with the technical assistance of Solange BERNSTEIN
and Gita POPEL

SUMMARY

Two antibiotic tests, the triphenyltetrazolium chloride test (TTC) and the Delvo test, were virtually unaffected by residues of several detergents and sanitizers in milk. The TTC test is more sensitive than the Delvo test to quaternary ammonium detergent, sodium hydroxide, or hypochlorite at high concentrations. In general, impairment of the organoleptic quality of milk was caused by residual concentrations much lower than those required for inhibition of antibiotic tests.

Key words : Milk - Organoleptic quality - Cleaning - Disinfection - Residues of detergents - Residues of detergents-sanitizers - Antibiotic tests.

RESUME

INFLUENCE DE LA PRÉSENCE DE TRACES RÉSIDUELLES DE DÉTERGENTS
ET DE DÉTERGENTS DÉSINFECTANTS
SUR LA VALIDITÉ DES TESTS DE DÉTECTION DES ANTIBIOTIQUES
ET SUR LA QUALITÉ ORGANOLEPTIQUE DU LAIT

Deux tests de détection d'antibiotiques du lait, le test TTC et le test Delvo ne sont en rien affectés par les résidus de divers détergents et désinfectants. Le TTC test est plus sensible que le Delvo test au détergent contenant de l'ammonium quaternaire, de l'hydroxide de sodium ou de l'hypochlorite à haute concentration. La qualité organoleptique du lait est affectée par des concentrations résiduelles de détergents ou désinfectants beaucoup plus faibles que celles requises pour l'inhibition des tests de détection d'antibiotiques.

Mots clés : Lait - Qualité organoleptique - Nettoyage - Désinfection - Résidus de détergents - Résidus de détergents-désinfectants - Tests antibiotiques.

Department of Food Science, Agricultural Research Organization, P.O. Box 6, Bet Dagan 50250, Israel.

Contribution from the Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel. No 1134-E, 1984 series.

I. INTRODUCTION

The problems associated with traces of cleaning and sanitizing agents in milk, range from impairment of the organoleptic or technological properties of the product and inhibition of manufacturing processes, to interference with tests used in quality control programs and to toxicological problems for the consumers (Dunsmore, 1983). The detergents are used to remove milk and other deposits from the surfaces of dairy equipment, while the sanitizers are used to reduce bacteriological contamination of milk due to unclean equipment. Another source of residues of sanitizers and detergents in milk, is in a cow hygiene program which includes udder washing prior to milking, teat dipping after milking and teat salve which may be applied to heal sores and lesions. The final amount of detergents and sanitizers in the milk is dependent primarily on the practice of use (Dunsmore, 1983). Numerous studies have led to the conclusion that detergents and sanitizers applied by « good practice » cause no residue problems in milk and dairy products (Heeschen, 1979; Kroger, 1979; Mannaert, 1979; Swartling, 1959). Other investigators who reported residues of detergents and sanitizers in milk supplies (Johns, 1954; Kosikowski et al., 1952), concluded that these amounts do not affect the growth of starter organisms.

Effects of detergents and sanitizers on antibiotic tests were reported by Richard and Kerherve (1973) and Freke and Booker (1981) for *B. stearothermophilus*, Kerherve and Richard (1971) for *S. thermophilus* and acidification test, Wildbrett (1962) for the triphenyl-tetrazolium chloride (TTC) test, and by Palmer (1964) for *B. subtilis* (Disk assay).

In the present work we determined the effect of residues of detergents and sanitizers in use in Israel, in the milk, on the performance of antibiotic tests and on the organoleptic quality of the milk.

II. MATERIALS AND METHODS

The detergents/sanitizers tested were those used in the dairy industry: sodium hydroxide — NaOH (Frutarom Ltd., Israel, recommended concentration — 20 g/l); quaternary ammonium compound — QAC (Proseptil-X, Sicca — Israel Chemical Enterprises, recommended concentration — 10 g/l); iodophore (Oxford IX-91 — Dexter Chemicals Ltd., Israel, recommended concentration — 25 mg/l); sodium hypochlorite (Frutarom Ltd., Israel, recommended concentration 250 mg/l); two commercial alkali materials (Neomuscan — Dr. Weigert, F.G.R., and Sterophos — Witco Chemical

TABLE 1

Inhibition of antibiotic tests and organoleptic quality of milk with added detergents and detergents-sanitizers

| Detergent-sanitizer | Concentration in milk sample mg/l | TTC test | Delvo test | Organoleptic quality* |
|-------------------------------------|---|----------|------------|--------------------------|
| <i>Iodophore</i> | | | | |
| Oxford IX-91 | 0.0125 | — | — | 0 |
| | 0.125 | — | — | 0 |
| | 1.25 | — | — | 3 |
| <i>Teat dipping iodine</i> | | | | |
| Polidin | 10 | — | — | 3 |
| | 50 | — | — | 4 |
| | 350 | — | — | 5 |
| Iodox | 0.1 | — | — | 0 |
| | 1 | — | — | 2 |
| | 10 | — | — | 3 |
| | 100 | — | — | 5 |
| | 400 | — | — | 5 |
| <i>Quaternary ammonium compound</i> | | | | |
| Proseptil X | 100 | — | — | 2 |
| | 500 | + | +/- | 3 |
| | 1,000 | + | +/- | 3 |
| <i>Alkali detergent</i> | | | | |
| Sterophos | 10 | — | — | 2 |
| | 100 | — | — | 4 |
| | 1,000 | — | — | 4 |
| Neomuscan | 10 | — | — | 2 |
| | 100 | — | — | 4 |
| | 1,000 | — | — | 4 |
| NaOH | 100 | — | — | 3 |
| | 1,000 | — | — | 5 |
| | 2,000 | + | — | 5 |
| <i>Chlorine</i> | | | | |
| Hypochlorite | 2.5 | — | — | 1 |
| | 25 | + | — | 4 |
| <i>Antibiotic control</i> | | | | |
| Chlortetracycline | 100 | ++ | ++ | — |
| | 250 | ++ | ++ | — |

* The residues were recorded at levels ranging from a detectable foreign taste = 5, to nondetectable foreign taste = 0.

Corp., Israel, recommended concentration for each 10 g/l); and two iodine containing formulae which are used for teat dips, iodophore (Iodox — Dexter Chemicals Ltd., Israel, recommended concentration 4 g/l) and povidone-iodine (Polidin — Fisher Pharmaceuticals Ltd., Israel, recommended concentration 3.5 g/l).

Commercial UHT milk served as a negative control, while UHT milk containing chlortetracycline (Sigma Chemicals Co.) was the positive control.

The detergents/sanitizers were added to the milk in concentrations ranging from, 10^{-1} of the concentration recommended by the manufacturers in cleaning solutions, to 10^{-4} lower. Due to the small amounts added, relative to the buffer capacity of the milk, even the addition of an acidic detergent such as iodophors, did not cause a color change in the test indicator prior to incubation. Antibiotic tests employed were the standard TTC test (Neal and Calbert, 1955) and the Delvo test (Gist-Brocades, The Netherlands).

The organoleptic quality of the milk with added detergents and sanitizers was determined by a panel of technicians and researchers in the laboratory.

III. RESULTS AND DISCUSSION

The TTC test was selected for this work since it utilizes *S. thermophilus*, a microorganism which is frequently used in cheese starter cultures and in fermented milk products, and is still most sensitive to penicillin — 0.005 IU/ml (Kosikowski, 1977). The results of the TTC antibiotic test are presented in Table 1. Only QAC, NaOH and hypochlorite at high concentrations exhibited inhibition of the test, while other detergents/sanitizers used did not show inhibition. It should be mentioned that the red color induced by these detergents/sanitizers was very faint, but still ruled as positive. The tetracycline was the only compound tested which yielded an obvious positive result. No single iodine compound, used for either general purposes or as a teat dip, showed any inhibitory effect at the concentrations tested.

The Delvo test is based on growing *B. stearothermophilus*, an organism which is most sensitive to antibiotics and produces large quantities of acid (Johnson *et al.*, 1977). The results for the Delvo test indicate a lesser sensitivity to chemical disinfectants in milk than those of the TTC test. This observed lower sensitivity of *B. stearothermophilus* in the Delvo test as compared to *S. thermophilus* used in the TTC test, was in agreement with the results of Richard and Kerherve (1973) who used the same bacterial cultures in the paper disk and acidification methods for detecting antibiotic residues.

The summary of the organoleptic qualities of the milk is presented in Table 1. The results show that the levels of detergents are detectable due to impairment of organoleptic quality of the milk in concentrations much lower than required for inhibition of antibiotic tests.

IV. CONCLUSIONS

The presence of traces of cleaning and sanitizing agents in milk does not affect the TTC and Delvo tests for antibiotics. The impairment of the organoleptic quality of milk is caused by concentrations much lower than those required for inhibition of antibiotic tests.

REFERENCES BIBLIOGRAPHIQUES

- DUNSMORE D.G., 1983. The incidence and implications of residues of detergents and sanitizers in dairy products. *Residue Rev.*, 86, 1.
- FREKE C.D., BOOKER R., 1981. Effect of common dairy farm detergents and sanitizers on the standard test for antibiotic residues. *N.Z.J. Dairy Sci. Technol.*, 16, 87.
- HEESCHEN W., 1979. Residues of drugs, antihelminthics and teat dips in milk and milk products. *Int. Dairy Fed.*, Doc. 46.
- JOHNS C.K., 1954. Iodophors as sanitizing agents. *Can. J. Technol.*, 32, 71.
- JOHNSON M.E., MARTIN J.H., BAKER R.J., PARSONS J.E., 1977. A comparison of several assay procedures to detect penicillin residues in milk. *J. Food Prot.* 40, 785.
- KERHERVE L., RICHARD J., 1971. Effect of residues of disinfectants in milk on activity of several species of lactic streptococci. *Rev. Lait. Fr.*, 291, 717.
- KOSIKOWSKI F.V., 1977. Cheese and Fermented Milk Foods, p. 16-36. Edwards Brothers Inc., Ann Arbor, Michigan.
- KOSIKOWSKI F.V., HENINGSON R.W., SILVERMAN G.J., 1952. The incidence of antibiotics, sulfa drugs and quaternary ammonium compounds in the fluid milk supply of New York State. *J. Dairy Sci.*, 35, 533.
- KROGER M., 1979. Chemical contaminants in milk. *Milchwissenschaft*, 28, 753.
- MANNAERT P., 1979. Detergents and disinfectants. *Int. Dairy Fed.*, Bull. 113.
- NEAL C.E., CALBERT H.E., 1955. The use of 2,3,5-triphenyltetrazolium chloride as a tests for antibiotic substances in milk. *J. Dairy Sci.*, 38, 629.
- PALMER J., 1964. Interference of sanitizers with antibiotic disk assay testing of milk. *J. Milk Food Technol.*, 27, 311.
- RICHARD J., KERHERVE H., 1973. Effect of disinfectants residues on two methods for the detection of antibiotics in raw milk. *Rev. Lait. Fr.*, 306, 127.
- SWARTLING P., 1959. The influence of the use of detergents and sanitizers on the farm with regard to the quality of milk and milk products. *Dairy Sci. Abstr.*, 21, 1,
- WILDBRETT G., 1962. The significance of adhering residues of cation-active disinfectants for the dairy industry. *Z. Lebensmitt. Untersuch.*, 118, 40.