Use of antimicrobial agents in official abattoirs under meat inspection in the United States of America

M.A. PATCH *

Summary: Facilities and equipment which are contaminated by a diseased carcass during slaughter and processing operations must be made free from microorganisms of human health concern before being used again. Therefore, a rapid-acting microbicidal agent is necessary to enable the swift resumption of operations. Currently, water heated to 180°F (82.2°C) is the antimicrobial agent of choice, as this rapidly kills microbes without leaving a residue which could jeopardize food products.


INTRODUCTION

Inspection of abattoirs in the United States of America (USA) prior to the 1906 Inspection Act was rudimentary and basically ineffective (4). The subsequent 1907 Act provided for an ongoing inspection programme. The challenge for the pioneering workers was to devise a programme which would detect and prevent the spread of disease and would protect products from contamination.

PREVENTION PROGRAMMES

A conservative but effective programme of prevention emerged. Ante-mortem inspection of animals at rest and in motion was prescribed to detect symptoms of disease. Those animals showing indications of infection were set aside and slaughtered separately.

The architects of the programme soon recognized that it was impractical to prove the presence of disease entities on exposed equipment. The laboratory tests available to provide such information were, and continue to be, time-consuming and expensive. The industry would have been crippled by a programme which depended entirely on laboratory results. Thus, a conservative but practical programme of prevention prevailed, while the search for applicable technology continues.

* United States Department of Agriculture, Food Safety and Inspection Service, 14th and Independence Ave, Washington, D.C. 20250, United States of America.
Each production day must start with scrupulously clean facilities and equipment. Continuous good ‘housekeeping’ and manufacturing practices are required throughout the day. Good housekeeping includes — but is not limited to — the removal of accumulated product residues. An example of good manufacturing practice is not allowing tubs which contact the floor or other contaminated surfaces to be placed on tables or other food-contact surfaces. These practices help to prevent cross-contamination.

Facilities and equipment which come into contact with residues from diseased carcasses during operation require special attention to prevent pathogenic microorganisms spreading to the product. Incisions into specific tissues and organoleptic inspections (by sight, smell and touch) were prescribed to detect lesions caused by invading microorganisms and large parasites. Diseased carcasses and viscera were isolated to prevent contact with other products. The contaminated facilities and equipment were then thoroughly cleaned and disinfected. The principles established by the founders of the programme have proved to be sound and are still observed today. However, microorganisms of food health concern to humans may remain undetected by the programme if they produce no visible lesions. These microorganisms are currently under study with a view to developing future improvements in the programme.

**DISINFECTANT AGENTS**

**Water heated to 180°F**

The authors of the first meat inspection regulations recognized that pathogenic microorganisms cannot be observed on surfaces during operation without the use of special laboratory procedures, and that cleaning alone could not be trusted to remove all such hazards. The objective of the regulations was to ensure that all pathogenic bacterial cells were killed; the word ‘sterilize’ therefore appeared in the regulations, and has been carried forward to the present. An inexpensive and rapid method for killing pathogens was required. Water heated to 180°F (82.2°C) was prescribed for this purpose. It was determined that water at this temperature would kill the vegetative forms of bacteria but would not kill the spores of anthrax, and 5% sodium hydroxide was prescribed for the latter purpose. It is therefore scientifically accurate to refer to water which is heated to 180°F and applied for a specified time as a ‘disinfectant’ (kills 100% of the target vegetative microorganisms) rather than as a ‘sterilizer’ (because it does not kill spores).

In the early days of abattoir inspection, small, slow-moving slaughter operations with little mechanization were the rule. In such operations, equipment and hand tools necessarily came into contact with carcasses of animals which demonstrated symptoms of abnormality on ante-mortem examination, and also with carcasses showing lesions during post-mortem processing and inspection. Equipment and hand tools which had been in contact with diseased tissue were immediately cleaned of visible residue and disinfected with water at 180°F. Contaminated facilities (e.g. floors and walls) were also cleaned and subsequently disinfected with water at 180°F.

As the industry became more sophisticated with the introduction of mechanized operations, the systems for applying water at 180°F also changed. Fast-moving equipment, such as continuous viscera tables, may come into contact with several animals before a diseased animal is detected and isolated. Therefore, cleaning of the equipment and application of water at 180°F are required for each revolution of moving table-tops or conveyor belts to ensure that a product placed on the line would not contact a surface previously contaminated by product residues from a diseased carcass.
Systems were thus installed for continuous cleaning and application of water at 180°F. Prior to the inspection point, hand tools and equipment used by plant employees are also cleaned and disinfected with water at 180°F between carcass contacts.

Lesions, such as deep-seated abscesses and inapparent joint infections, may be revealed when carcasses are reduced during cutting, boning and slicing operations. When this occurs, the operation is stopped. Product which is not contaminated is removed from the immediate vicinity. The contaminated equipment and hand tools are isolated, cleaned and disinfected with water at 180°F. Similarly, contaminated facilities are also cleaned and disinfected before operation recommences.

Tests were conducted in a laboratory of the United States Department of Agriculture (A.B. Moran, unpublished findings, 1978) to determine the time required to kill the vegetative cells of microorganisms using water at 180°F. *Pseudomonas aeruginosa* and *Staphylococcus aureus* were killed in five seconds, while *Salmonella choleraesuis* was destroyed in fifteen seconds. Encapsulated tubercle bacilli required exposure for 19.8 seconds (1, 2, 3). Under operating conditions, equipment absorbs heat and therefore longer times may be necessary to bring the surface of specific equipment up to the temperature required to kill the microorganisms. Although not codified into regulations, higher water temperatures will reduce the kill time for microbes on equipment surfaces while minimizing the absorption of heat by metal equipment.

**Antimicrobial chemicals**

Under the Federal Insecticide, Fungicide and Rodenticide Act, chemicals for antimicrobial activity marketed in the USA must be registered for specified purposes with the Environmental Protection Agency (EPA). A variety of chemicals have been registered for the ‘sanitation’ of previously-cleaned equipment and as hand sanitizers. Specific instructions for the use of these products in meat and poultry establishments appear on the labels of compounds registered with the EPA or in accompanying registered instruction documents. These chemicals produce a percentage reduction in the number of bacteria in a mixed population but do not destroy 100% of the vegetative microorganisms; such chemicals are therefore not approved for the disinfection of equipment contaminated by diseased carcasses in federally-inspected abattoirs.

At present, no chemical ‘disinfectants’ are registered with the EPA for use in the meat and poultry industry in place of water at 180°F. By definition, disinfectants kill 100% of the target vegetative microorganisms; therefore, if and when such chemicals are registered for use in the meat and poultry industry, they could replace the application of water at 180°F. There is some evidence that free-rinsing compounds (e.g. halogens) which are currently registered by the EPA as hospital disinfectants may be adaptable for use in abattoirs. Current test methods for the registration of a chemical as a hospital disinfectant prescribe exposure for 10 min; in the meat and poultry industry, however, contaminated equipment must return to service much more quickly. Water at 180°F therefore remains the treatment of choice for disinfecting equipment contaminated by residues from diseased carcasses, as this disinfects surfaces rapidly and does not leave a chemical residue. Chemical disinfectants may be available which could provide the same rapidity of microbial kill without chemical residue. However, acceptable test methods must be devised to demonstrate the efficacy of such compounds before they could be considered for registration.
UTILISATION D'AGENTS ANTIMICROBIENS DANS LES ABATTOIRS RELEVANT DE L’INSPECTION DES VIandes AUX ÉTATS-UNIS D'AMÉRIQUE. - M.A. Patch.

Résumé : Les installations et matériels contaminés par un animal malade pendant l’abattage et à l’occasion du traitement de la carcasse doivent être débarrassés de tous micro-organismes présentant un risque pour la santé publique avant d’être remis en service. Il faut donc un microbicide à action rapide pour permettre une reprise des activités dans les meilleurs délais. L’eau chauffée à 180 °F (82,2 °C) constitue actuellement le meilleur agent antimicrobien. Ce type de traitement permet en effet de détruire rapidement les microbes sans laisser de résidus nocifs.


USO DE AGENTES ANTIMICROBIANOS EN LOS MATADEROS ESTADOUNIDENSES EN QUE EXISTE INSPECCIÓN DE CARNES. – M.A. Patch.

Resumen: Las instalaciones y los distintos materiales de los mataderos que han sido contaminados por animales enfermos durante la matanza o durante el procesamiento de las carnes deben quedar limpios de todo microorganismo que pueda representar riesgos para la salud pública antes de volverse a utilizar. Esto requiere el uso de un microbicida de acción rápida, capaz de permitir sin mayor tardanza la reanudación de las actividades. El agua caliente a una temperatura de 180°F (82,2°C) es en la actualidad el mejor agente antimicrobiano, pues permite destruir rápidamente los microbios sin dejar residuos nocivos que comprometan los productos pecuarios.


REFERENCES


