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Meat Industry Services

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Instrumental Detection of Areas Requiring Spot Treatment

Spot treatment of carcasses, is commonly associated with traditional trimming of visible contamination or with steam vacuuming. Not all contamination is visible, however, and many pathogens and spoilage microorganisms may remain on a visually clean carcass. Thus there is a move to use methods other than human sight to detect the spots to which the treatment is to be applied. Some of these detection methods are outlined below.

Detection of contamination

Visual

Traditionally, carcasses are inspected, and offending areas of contamination trimmed by hand. This is effective for areas of visual contamination, and some bile staining, but can be hampered by poor lighting at the inspection point or a fast-moving chain where there is little time allowed for the QC inspection and trim (It also helps if the operative is not colour blind!).

Chlorophyll detection

The natural constituents of green plants, chlorophyll *a*, chlorophyll *b*, and protoporphyrin IX, absorb electromagnetic radiation of wavelength 400-475nm, and this energy causes them to emit electromagnetic radiation, or *fluoresce*, at a wavelength of 630-700nm. Meats, similarly, absorb and emit electromagnetic radiation, but in different wavelength bands – excitation occurs optimally at 360nm, and emission at 420-520nm. When 420nm radiation is applied to meat, meat fluorescence is suppressed but the plant constituents will fluoresce (Kim *et al.* 2003).

The technology allows the detection of contamination that is not visible to the naked eye, and is truly objective – if there is no plant matter, there will be no fluorescence in the detectable band. It can be used on carcass meat and on other surfaces, and gives an immediate result, so corrective action can be taken in real-time. Because it is detecting green plant matter, it does depend on the animals being fed a chlorophyll-based diet, and there has been little success in its use on animals such as pigs and poultry. Where ruminants are purely grain-fed, and the diet contains little chlorophyll, the technology is less reliable than where the animals are grass-fed. False-positives may occur where light is reflected from the surface at the critical wavelength for detection, and this can happen on excessively wet carcasses, the moisture reflecting the light. Bone and some connective tissues may also reflect the light. Some vegetable-based marking inks have also been noted to fluoresce, as they too contain the green plant constituents. The technology is available as a carcass cabinet, or as a hand-held unit, the latter of which is easy to use with only a little practice, but it is affected by ambient light levels – if the surroundings are too brightly lit, the fluorescence will not be detected so easily.

Preliminary work in the UK has shown that although there is no direct correlation between fluorescence and bacterial contamination, there is a good relationship between the extent of the fluorescence and the probability of having high microbial counts on the carcass (Reid *et al.* 2005).

The Verif-Eye system is manufactured by E-Merge International (www.verifeye.net), and distributed in Australia and New Zealand by:

Argus RealCold Ltd:

PO Box 12-915

9 Prescott Street

Penrose, Auckland

New Zealand.

www.realcold.nz.

Tel: +64 9-526-5757 (Graham Dun).

Bacterial Fluorescence

AgroMicron are carrying out final testing of a harmless chemical spray which contains a luminous molecule that will bind to pathogens such as *Salmonella enterica* or *E. coli* O157, so that it will glow on the surface of the meat. They have applied for FDA approval, and are hoping that the technology will be commercially available mid-2006.

www.agromicron.com.

Infrared Spectroscopy

Infrared spectroscopy (IR) works on the basis that the chemical bonds within an organic molecule will absorb or emit infrared light when they change from one energy level to another, in response to excitation by light at a particular wavelength, or heat. The emitted infrared light can be detected in a similar fashion to that outlined above for chlorophyll detection. Currently, IR is used to a very limited extent in the meat industry, for determining the fat content, and has been evaluated for assessing spoilage (Ellis and Goodacre 2001), but it has the potential to be used for detection of bacterial contamination on

meat, as bacterial cells will produce a different emission wave from the meat itself (van Kempen 2001). This technology is not yet commercially available, but trials are underway in a number of research centres worldwide.

Bacterial ATP detection

All living cells are powered by energy units of adenosine triphoshate (ATP), and this energy unit can be used to drive a bioluminescence reaction, that occurs naturally in fireflies. The more ATP there is, the more power, so the brighter the luminescence, just as in a bicycle dynamo powering the lamp. This technique has been used to detect residual organic material on surfaces after cleaning, as it detects the presence of living cells. The kits available are very easy to use, giving a result in the form of a luminosity figure in minutes, the greater the figure, the more cells there are on the swabbed surface. Total ATP measurement, however, does not distinguish between bacterial cells and body or meat cells, so is not useful for carcass testing.

New, sophisticated ATP systems have been developed where the carcass can be sponged, and the sponge treated with a chemical to remove the body cells, so that the ATP detected is of bacterial origin only. These systems give results in 5 minutes, and can detect levels as low as 2-3 $\log_{10}$ cfu/cm^2 on carcasses (Siragusa *et al.* 1995). Further research is in progress to produce systems that will detect specific organisms, allowing processors to target particular pathogens of concern.

ATP detection is currently probably of more use as a hygiene monitoring tool than for targeting contamination on an individual carcass.

www.biothema.com; www.berthold.com.au; www.bestlab.com.au

Detection of microbial phosphatase

Phosphatase is an enzyme that occurs naturally in most raw foods and in microorganisms. Testing for this enzyme is commonly used in the dairy industry to assess the efficacy of pasteurisation. The phosphatase produced by microorganisms is more resistant to heat than body/meat phosphatase, so a sample of carcass surface is heated to 75°C for 7 minutes, to remove the meat phosphatase. The microbial phosphatase can then be detected using a simple chemical reaction, the products of which can be measured by colour analysis or fluorescence techniques, giving a numerical result in approximately 10 minutes. The greater this number, the more microorganisms present on the sample.

This test also is probably of more use as a hygiene monitoring tool than for targeting contamination on an individual carcass, although a kit aimed at carcass monitoring gave a good correlation with carcass microbial count (Kang and Siragusa 2002).

www.cytoskeleton.com (Note: These are very technical kits, and are more targeted at commercial laboratories rather than for use in the field.)

References

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