

Rapid Communication

Rapid estimation of the bacteriological quality of fresh fish by impedance measurements

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Abstract

The suitability of capacitance measurements by the Bactometer Monitoring System for a quick differentiation between good, poor and moderate quality of cod fillets, was tested.

The application of Brain Heart Infusion broth as growing medium for capacitance measurements gave very small differences between duplicate measurements, if any.

Both at 20 and 30°C these measurements correlated very well with the results of conventional methods for the determination of psychrophilic and mesophilic count respectively. The correlation coefficients were -0.93 and -0.95.

For raw fish like cod fillets, measurements at 20°C are to be preferred because bacteriological quality defects revealed at 20°C were masked at 30°C in some cases.

Introduction

It is of interest for food producing industries to get information about the microbiological quality of their products as early as possible. In the past decade several instruments have been developed which provide information on microbiological quality much earlier than the conventional methods do.

Gibson et al. (1984) estimated the bacteriological quality of fish by automated conductance measurements using the Malthus Analyser. This method was also used for predicting the shelflife of packaged fish (Gibson, 1985). The Bactometer Monitoring System was tested for its suitability to give a rapid estimation of the bacteriological quality of fresh (non-frozen) cod fillets.

Material and methods

Material

The majority of the samples were obtained from retail shops. In order to obtain samples with very high counts, some samples were stored overnight at ambient temperatures. Samples with very low counts were obtained by filleting very fresh cod at the Institute.

Methods

The samples were homogenized (1:10) with a pepton-saline solution in a Stomacher. The suspensions were poured into tubes in order to allow the fibres to settle. The supernatant was used for both the impedance measurements and the bacteriological analyses. For the impedance measurements, the suspensions were mixed with an equal volume of double strength Brain Heart Infusion broth (BHI, Oxoid CM 225). The Bactometer Microbial Monitoring System, M-120 M1 version 4 of Bactomatic Inc. was used. The detection times (hours) resulting from changes in the capacitance measurements were carried out in duplicate at both 20 and 30°C and were compared with the initial bacterial counts for psychrophiles (15°C) and mesophiles (30°C) obtained by conventional methods (Van Spreekens, 1974, Toepoel, 1980).

From preliminary experiments the following facts had appeared:

- Using the Bactometer system the capacitance signal detected faster and produced a better curve shape than the conductance signal.
- Compared to the trimethylamineoxide containing medium used by Gibson et al. (1984) for conductance measurements by the Malthus, BHI broth gave shorter detection times and only very small differences in duplicate values. For this reason BHI broth was used.
- The presence of muscle fibres may interfere with the electrical measurements for which reason removal of the fibres is strongly advised.
- The addition of 0.1% Tween 80 to the peptone-saline solution did not have any noticeable effect on the measurements nor on the bacterial counts.

Results and discussion

The scattergrams of the experimental data, logarithm of mesophilic and psychrophilic count per gramme versus the average detection time (DT) at 30 and 20°C are shown respectively in the figures 1 and 2.

In both cases the correlation coefficient was high which means that conventional methods were in good agreement with the electrical method. From the limit to be set to the bacterial count of the product the corresponding detection time can be read. This is called the permissible detection time. The permissible detection time plus respectively minus the standard deviation results in values which are called caution time and cutoff time (Firstenberg Eden and Eden, 1984). With these values we have a standard measure to differentiate - with >95% probability - between samples of very poor quality ($DT \leq \text{cutoff time}$) and those of very good quality ($DT > \text{caution time}$). This differentiation cannot be made for a detection time between the cutoff and the caution time, the grey zone. These samples should be analysed by conventional methods.

It appeared from this experiment too, that due to the psychrophilic nature of the bacterial flora of fresh marine fish, the bacterial counts determined at 15°C were about 10 times as high as the bacterial counts determined at 30°C.

At the two limits chosen for the bacterial counts, viz. 5×10^5 and 5×10^6 , the cutoff time was in both cases approx. 5 hours. The caution time determined at 20°C was over an hour longer than that at 30°C (see figures 1 and 2). Yet, for fresh fish, impedance measurements at 20°C are to be preferred because 14% of the samples which had a detection time at 30°C beyond the caution time had a detection time at 20°C below the cutoff time or within the grey zone, whereas the opposite was not observed.

Therefore a temperature of about 20°C is advised for the quick screening of samples of fresh fish by electrical measurements.

References

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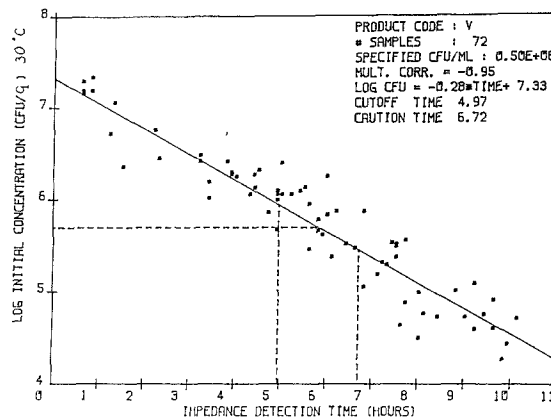


Figure 1. Relation between detection time at 30°C and mesophilic aerobic count of cod fillets

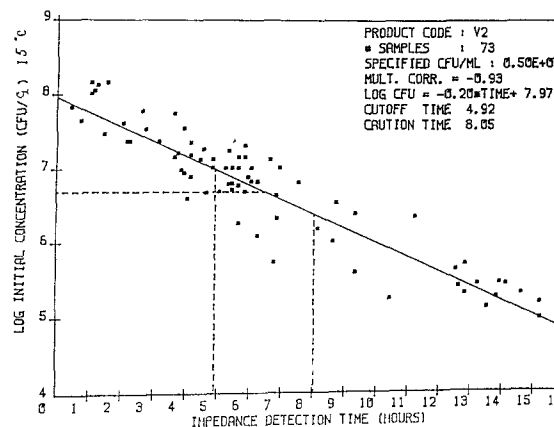


Figure 2. Relation between detection time at 20°C and psychrophilic aerobic count of cod fillets

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