techniques of sample preparation for liquid scintillation counting

BRIAN W FOX

TECHNIQUES OF SAMPLE PREPARATION FOR LIQUID SCINTILLATION COUNTING

Brian W. Fox

Paterson Laboratories,
Christie Hospital & Holt Radium Institute,
Manchester, England

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Preface

The use of weak beta-emitting radioisotopes in an increasing variety of investigative procedures, particularly in the biochemical field, has stimulated the demand for better methods of assaying those isotopes which are more conveniently incorporated into organic molecules employed as precursors.

The prime object of the present work is to bring together the many different ways that have been designed to prepare the samples in a form suitable for liquid scintillation counting. Although the prime object is to bring the weak beta-emitter into close molecular contact with the primary solvent in the system, the method of doing this is highly dependent on the nature of the sample being measured. The initial sample for assay can exist in any state and associated with many other components which exceed the concentration of the actual beta emitter by many orders of magnitude. Where the level is low, careful thought should be given to the possible means whereby the labelled material itself may be isolated or alternatively the contaminating materials removed from the labelled substance. Occasionally, either one of these processes may be effected by solvent extraction, but before doing so, the sample multiplicity must also be considered. The number of samples may be too great to allow even a simple process of this kind to be conducted within a reasonable time. A decision as to whether or not such a tedious extraction procedure should be contemplated will depend on the level of accuracy needed by the experiment.

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Such decisions are often overlooked before assay and many users of liquid scintillation instruments rely solely on the claims of the many commercial scintillation cocktails available, hence incurring unnecessary expense. Often in addition, incorrect application of such cocktails may produce anomalies which are thought to be associated with the experiment itself rather than with the counting conditions employed.

In every counting technique used, some form of 'quenching' (see § 1.2) will be experienced. This reduction of counting efficiency can usually be accurately assessed and allowed for in a number of different ways. However, there are certain situations where these correction procedures cannot be used. It is in these circumstances that anomalous results usually appear and are often unrecognised by the experimenter.

In many, and probably in most biochemical applications, it may not be essential to obtain an accurate assessment of the absolute level of isotope present. Reproducibility of sample counts by careful control of the sample preparation is often the goal to be achieved. The ability to conduct several hundred measurements with a reproducibility of one and often up to 5 % between samples is often all that is necessary. The correct initial choice of counting method at the outset will be repaid by the avoidance of many hours of tedious and unnecessary sample preparation, which may otherwise be costly not only in time consumed but also in the preprocessing and scintillation materials used.

Most of the confusion arising from apparently conflicting data in the literature on sample preparation methods, appears to arise from the fact that many authors consistently refrain from stating the reference efficiency of the machine being used. It is thus not possible to determine from the work, whether the increased efficiencies apparantly obtained by his method is indeed an improvement or just a demonstration of the acquirement of a scintillation counter with improved engineering. Also since a judicious choice of window settings can appear to confer increased efficiency, open window data should be quoted in making such comparisons for single isotopes. This would avoid giving artifactual increases by quench shifts into lower windows.

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