Method to determine DPM (Disintegrations Per Minute) for dual label samples without using quench correction curves

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This method allows the determination of the activity in DPM or Becquerel of two isotopes using liquid scintillation counting. The method has some limitations but is robust and may be used to determine isotopes for which there is no quench correction curve available.

Method:

The user has to determine 4 different efficiency values and use two different energy regions.

Determine the efficiency of the lower energy isotope in the lower energy region and also in the higher energy region

Determine the efficiency of the higher energy isotope in the lower energy region and also in the higher energy region

Procedure:

Build an assay or protocol using CPM as the count mode and set two energy regions: - the lower energy region K and the higher energy region J. The regions will generally be set from 0 (zero) to the Emax of the lower energy isotope and then from that Emax to either the Emax of the higher energy isotope or to the extent of the energy range.

Examples:	Tritium and Caesium	0 – 12 keV and 12 to 2000 keV
	Carbon 14 and Phosphorous 32	0 – 156 keV and 156 to 1710 keV

Take a pure standard of the lower energy isotope and count it in the two regions.
Record the CPM value in the two regions i.e. CPMA and CPMB
Calculate the efficiency of counting for the lower energy isotope in the lower energy region with the following equation called Kl

$$Kl = \left(\frac{CPMA}{DPMlower\ energy\ isotope}\right)$$

Calculate the efficiency of counting for the lower energy isotope in the higher energy region with the following equation called Kh

$$Kh = \left(\frac{CPMB}{DPMlower\ energy\ isotope}\right)$$

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Take a pure standard of the higher energy isotope and count it in the two regions. Record the CPM value in the two regions i.e. CPMA and CPMB
Calculate the efficiency of counting for the higher energy isotope in the lower energy region with the following equation called Jl

$$Jl = \left(\frac{CPMA}{DPM\ higher\ energy\ isotope}\right)$$

Calculate the efficiency of counting for the higher energy isotope in the higher energy region with the following equation called Jh

$$Jh = \left(\frac{CPMB}{DPM\ higher\ energy\ isotope}\right)$$

Now there are 4 efficiency values:

Kl – efficiency of the lower energy isotope in the lower energy region
Kh - efficiency of the lower energy isotope in the higher energy region
Jl – efficiency of the higher energy isotope in the lower energy region
Jh - efficiency of the higher energy isotope in the higher energy region

When the efficiencies have been established the unknown sample may be counted and it may contain both isotopes. The quench value of the unknown sample must always be as close as possible to the quench value of the standards that were used to determine the efficiencies.

When the CPM values of the unknown samples have been determined then there are two calculations that must be done off line. The DPM of the lower energy isotope and the DPM of the higher energy isotope must be calculated separately.

DPM of the lower energy isotope uses this equation:

DPMK = $(CPMA \times Jh - CPMB \times Jl) \div (Jh \times Kl - Jl \times Kh)$

DPM of the higher energy isotope uses this equation:

DPMJ = $(CPMB \times Kl - CPMA \times Kh) \div (Jh \times Kl - Jl \times Kh)$

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Limitations:

The quench value of the standards used in setting up the efficiencies and the quench value of the unknown samples must by very close to each other or the process will not be accurate. Therefore the matrix of the standards and the matrix of the samples must be the same. It would be recommended that the unknown sample is produced and all the components are put in the sample but without activity. Then the standard activity may be put in those sample types. Then when the unknown samples are produced they should have the same formulation.

The values of DPM in the two regions must be done off line. This is tedious but may be done by spreadsheet once the efficiency values are known and would only involve entering the CPMA and CPMB values each time.