

## Counting efficiency of a double-well single-plastic scintillation counter to commercially available radionuclides (Tl-201, Tc-99m, I-123, Ga-67, In-111 and I-131)

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A new type of well-scintillation counter with a double-well and single-plastic scintillator (DW-counter) was developed to simplify time consuming and cumbersome dilution procedures inherent to *in-vivo* sample measurement. It has the potential to measure many radionuclides which emit a gamma ray or positron. We tested the counting efficiency (CE) of the DW-counter (DCM-200, Aloka Co., Tokyo, Japan) with respect to 6 radionuclides. **Materials and Methods:** The outline of DW-counter is altered to a single unit as compared to the prototype, while its basic mechanical constitution was not changed. Six commercially available radionuclides (Tl-201, Tc-99m, I-123, Ga-67, In-111, I-131) were used in this study. For each radionuclide, we prepared two standard solutions containing high (>100 MBq/ml) and relatively low radioactivity (10–20 MBq/ml). The radioactivity (Bq) of the radionuclide in each sample at time = 0 was measured with a dose calibrator. Afterwards, it was determined from a decay-time with correction by the physical half-life of each radionuclide. Count rate (cps) of each standard sample was measured in each well ten times per sample. The counting efficiency (CE) of the counter for each radionuclide was determined by measured count rate (cps)/standard radioactivity (Bq)  $\times$  100 (%). The conversion constant (CC) which predicts standard radioactivity (Bq) from measured count rate (cps) was obtained as a reciprocal value of the CE. **Results:** The CE (mean  $\pm$  SD) in well-A to Tl-201, Tc-99m, I-123, Ga-67, In-111 and I-131 was  $5.90 \pm 0.285\%$ ,  $8.56 \pm 0.0981\%$ ,  $8.33 \pm 0.344\%$ ,  $7.77 \pm 0.15\%$ ,  $16.4 \pm 0.495\%$  and  $10.2 \pm 0.139\%$ , respectively. They were significantly different. The coefficient of variation of the measured count rates was less than 1% in radioactive range higher than  $10^3$  Bq in well-A and  $10^6$  Bq in well-B. The difference in the CE between well-A and -B ranged from  $7.614 \times 10^2$  (I-131) to  $9.395 \times 10^2$  (Tl). The CC ranged from 6.14 (In) to 17.15 (Tl) in well-A and from  $5.05057 \times 10^3$  (In) to  $15.83773 \times 10^3$  (Tl) in well-B. The CE was not significantly affected by a sample volume from 1 to 4 ml in well-A, but showed a slight difference in well-B, which seemed due to a collimation. **Conclusion:** The measurement error of the DW-counter was less than 1% and the measured count rate (cps) was exactly converted to the standard radioactivity (Bq) by determined CC. The counter is considered useful in the easy evaluation of *in-vivo* tracer kinetics by avoiding time consuming and cumbersome dilution techniques.

**Key words:** plastic scintillator, well counter, counting efficiency, *in-vivo* pharmacokinetics