Letters to the Editor should be typed doubled-spaced (including references) with conventional margins. The overall length is limited to five manuscript pages, including not more than one figure or one table.

Microcomputer Program for RIA Data Reduction and Data Acquisition from an Interfaced Gamma Counter

To the Editor:

I have written a microcomputer program for RIA data reduction and analysis, in BASIC language, useful for a clinical radioimmunoassay section. The program can be used for automatic transmission or for manual introduction of the data from the gamma counter to the microcomputer. In my laboratory, I have interfaced a Multi-Prias Gamma Counting System with a single detector, to an HP-86 personal computer.

Hardware description:
1. Microcomputer system: a microcomputer HP-86 with a built-in user memory of 64K bytes and with the option of a 12-in. monitor; two disc-drives HP-9130A, storing 270K bytes on one disc (5¼); a thermal printer HP-2671A (printing speed: 120 char/s and 190 char/s bidirectional; a graphic plotter HP-7470A with two built-in pen stalls for two-color plotting. Additionally, a serial interface HP 82939 (RS-232C), an HP-82937A HP-IB interface, an HP plotter ROM, an HP I/O ROM are needed (all from Hewlett-Packard Co., Personal Computer Division, Corvallis, OR 97330).
2. Multi-Prias Gamma Counting System with a single detector (United Technologies Packard—Packard Instruments, Downers Grove, IL 60515).

Software description:
The program has been written in BASIC language and it uses two disc-drives. A master program disc consists of 15 interlinked programs, selected by the user by using function keys. The second disc collects the protocols for 36 different RIA tests (completely selectable) and stores the last counting run (counts/min mode) for each test, up to 200 samples for test.
The parameters for each radioimmunoassay—number of samples, standards (up to 10), number of replicates (up to 5), blanks, nonspecific binding samples, totals, measure units, normal values, date, observations, and manufacturers—are always modifiable. The main features of this fully interactive program are:
1. Manual (through the keyboard) and automatic transmission of the counting to the microcomputer.
2. Standard curve fitting by several methods:
(a) Logit/log transformation (unweighted and weighted) by linear regression least squares.
(b) Cubic spline function, with counts/min vs concentration, counts/min vs log(C), and B/B₀ vs log(C).
(c) Interpolation by high-order polynomials, with B/B₀ vs log(C), T/B vs concentration, and counts/min vs concentration.
3. Graphic presentation of standard curves with automatic calculation of the scale factor, with the HP-86 monitor or the plotter for the hard-copy.
4. Deletion of one or more standard points (outliers) with immediate recalculation of the standard curve.
5. Recalculation of the same samples' values for a test, with a different fitting method for checking differences between methods.
6. Printout of the results for the samples, with the indication of the coefficients of variation, number of replicates, and standard deviation.
7. Printout of some parameters for evaluating the goodness of the standards fitting (e.g., the differences between the theoretical values of the standards' concentrations and the calculated values by a particular method, the correlation coefficient, slope and y-intercept).
8. Panel tests fully selective and easily modifiable.
9. Execution of tests such as plasma renin activity (PRA), immunoradiometric assay (IRMA), enzyme immunoassay (for instance, CEA EIA Roche).

This program is available on floppy disc or printout, on request from the author or the Editorial Office of this journal.

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Angiotensin-Converting Enzyme: Confusion about Activity Units

To the Editor:

Ways of measuring serum angiotensin-converting enzyme (ACE; dipeptidyl carboxypeptidase, EC 3.4.15.1) have proliferated, and now include liquid-chromatographic (I), enzymic (2), colorimetric (3), and kinetic (4) methods. For each of these, as well as for the earlier ACE methods, the enzyme activities have been reported in a variety of units: units (5), units/mL (6, 7), int. units/mL (8), nmol/min/mL (9, 10), U/mL (11), U/L (1, 2, 12), and kU/L (13–15).

The origin of this confusion appears to be Lieberman's expression of enzyme activity: nanomoles of hippuric acid formed per minute at 37 °C per milliliter of serum. This at once puts it at odds with the unit abbreviated as U, which is defined by the International Union of Biochemistry as the amount of enzyme that will transform 1 μmol of substrate per minute per milliliter of specimen. Because the amount of substrate transformed or the product formed is small (nmol), the activity of most clinically important enzymes, including ACE, is in the order of mU/mL or, more simply, U/L.

Lieberman's unit thus is in fact an arbitrary unit, which should be defined in each report in which it is used. To change it to U, values measured in this arbitrary unit should be divided by 1000; otherwise, the use of "U" is incorrect.

The variety of ACE methods making use of different substrates gives rise to numerically different reference ranges. ACE values should be reported with a reference range to avoid ambiguity of inter-laboratory results.

References

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Biological Variation of Lactate Dehydrogenase Isoenzyme-1/Isoenzyme-2 Ratio

To the Editor:

Recently we reported on the findings on the biological variation of lactate dehydrogenase (EC 1.1.1.27; LD) isoenzymes in a group of healthy subjects (J). We showed that serum LD-1, unlike all other LD isoenzymes, is under tight homeostatic control and thus exhibits high individuality. This finding suggests that the use of LD-1 measurement (2,3) or of the LD-1/total LD ratio (3) as a diagnostic test for myocardial infarction may be subject to significant intra-individual variation, which would diminish the diagnostic usefulness of this test. The LD-1/LD-2 ratio is also used as a diagnostic test for myocardial infarction (4–7); the question then arises as to the usefulness of its group-specific reference range.

Accordingly, we now report the biological variance of the LD-1/LD-2 ratio in the 24 healthy persons used in our previous study (J).

Using LD-1 and LD-2 data already in computer files, we calculated the LD-1/LD-2 ratios for triphasic analyses for each of the 24 persons (12 men, 13 women, age range 23–50 years, average age 32.2 years) over the entire 12-month period. Blood was sampled from each subject by venipuncture once weekly for 2 weeks and twice monthly for the following 10 months. All samples were taken between 0900 and 0930 h after individuals had fasted for 10 to 12 h. Specimens were processed routinely and analyzed on the same day. The 24 persons, who were randomly selected from the clinical biochemistry laboratory staff, were nonsmokers, took no medications known to alter serum LD and isoenzyme activities, and did not consume excessive amounts of alcohol during the study period. Although subject 15 (Table 1) was taking prescribed doses of synthetic T-thyroxin, thyroid-function tests and LD activity were normal throughout the study. Hypothyroid patients on replacement therapy have been shown to have normal serum LD and isoenzyme activities (8).

LD isoenzymes were separated by thin-layer electrophoresis on agarose gel, and activities were quantified fluorometrically (6) with the "Clinichrom" (Helena Laboratories, Beaumont, TX 77704). Total LD activity was determined on the 6800 Reaction Rate Analyzer (LKB Instruments Inc., Rockville, MD 20852) with BCC reagents (Boehringer Mannheim Canada Ltd., Quebec, Canada). Normal reference intervals for LD-1, LD-2, and LD-1/LD-2 were 14–26%, 29–36%, and 0.45–0.74 (5), respectively.

Table 1 summarizes subject demographics, results of overall means, and their respective variations for LD-1, LD-2, and LD-1/LD-2. Means of triplicates were significantly different (p <0.01) among individuals. The pattern of variation of the LD-1/LD-2 ratio, like the individual isoenzymes, was characteristic of the individual. There were no significant differences in subjects' means with respect to age, sex, or season (p <0.05), nor were there any significant differences between weekly and bi-weekly means for a given person. Unlike the subjects' means for LD-1 and LD-2, which were all within the previously established reference interval, 17% (four of 24) of the subjects had mean LD-1/LD-2 ratios slightly above the upper limit of normal. The reason for this is not clear. The magnitude of within-person variation (%CV) of LD-1/LD-2 was greater than that of LD-2 in 88% and less than that of LD-1 in 64% of all subjects. The intra- to inter-individual standard deviation ratio (0.67) was intermediate between those of LD-1 (0.26) and LD-2 (1.45).

These results indicate that the LD-1/LD-2 ratio is less person-specific than

![Table 1. Individuals’ Mean Values for LD-1, LD-2, and LD-1/LD-2, and Their Variations in 24 Healthy Subjects during 12 Months](image-url)

<table>
<thead>
<tr>
<th>Subject’s age, sex, race</th>
<th>LD-1</th>
<th>LD-2</th>
<th>Mean (and %CV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, F,W</td>
<td>20.8 (5.8)</td>
<td>32.2 (8.5)</td>
<td>0.65 (5.0)</td>
</tr>
<tr>
<td>3, M,W</td>
<td>23.1 (5.9)</td>
<td>31.7 (3.0)</td>
<td>0.73 (5.4)</td>
</tr>
<tr>
<td>5, F,W</td>
<td>22.4 (6.6)</td>
<td>32.9 (4.9)</td>
<td>0.88 (5.9)</td>
</tr>
<tr>
<td>7, M,W</td>
<td>22.7 (5.3)</td>
<td>32.3 (5.0)</td>
<td>0.73 (4.8)</td>
</tr>
<tr>
<td>8, M,W</td>
<td>21.4 (3.5)</td>
<td>31.5 (5.4)</td>
<td>0.68 (5.0)</td>
</tr>
<tr>
<td>10, F,W</td>
<td>23.8 (3.0)</td>
<td>32.4 (3.6)</td>
<td>0.73 (4.4)</td>
</tr>
<tr>
<td>12, F,W</td>
<td>14.2 (13.8)</td>
<td>27.1 (6.7)</td>
<td>0.52 (9.7)</td>
</tr>
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<td>13, M,W</td>
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<td>0.68 (8.8)</td>
</tr>
<tr>
<td>14, F,W</td>
<td>23.3 (8.9)</td>
<td>32.5 (5.9)</td>
<td>0.72 (5.7)</td>
</tr>
<tr>
<td>15, F,W</td>
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<td>31.7 (4.7)</td>
<td>0.68 (5.0)</td>
</tr>
<tr>
<td>16, F</td>
<td>25.3 (6.7)</td>
<td>32.9 (4.2)</td>
<td>0.77 (6.7)</td>
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<tr>
<td>17, F,W</td>
<td>23.3 (5.6)</td>
<td>31.6 (4.3)</td>
<td>0.74 (7.1)</td>
</tr>
<tr>
<td>18, M,W</td>
<td>20.4 (4.0)</td>
<td>31.4 (4.4)</td>
<td>0.65 (5.1)</td>
</tr>
<tr>
<td>19, M,W</td>
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<td>31.8 (5.5)</td>
<td>0.67 (7.5)</td>
</tr>
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<td>20, F,W</td>
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<td>30.8 (5.2)</td>
<td>0.80 (6.0)</td>
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<td>32.7 (4.7)</td>
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<tr>
<td>25, M,W</td>
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<td>31.1 (5.1)</td>
<td>0.68 (5.0)</td>
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<tr>
<td>26, F,W</td>
<td>19.4 (5.8)</td>
<td>32.3 (4.3)</td>
<td>0.90 (7.1)</td>
</tr>
</tbody>
</table>

Mean values are percent of total LD activity. M = male, F = female, W = whites, A = asians, B = blacks, CV = coefficient of variation.