POINTE SCIENTIFIC, INC.
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Lactate Dehydrogenase (Liquid) Reagent Set

Intended Use
For the *in vitro* quantitative kinetic determination of lactate dehydrogenase activity in serum.

Clinical Significance
Increased levels of LD are associated with myocardial infarction. Levels reach a maximum approximately 48 hours after the onset of pain and persist about ten days. The degree of elevation is of value in assessing the extent of damage and in developing a prognosis. LD elevations are also observed in liver disease, pernicious anemia, in some cases of renal disease, and in some cases of skeletal muscle trauma.[1]

Method History
Wroblewski and Ladue[2] published the first UV kinetic method for the determination of LDH activity in serum in 1955. Their method was based on the classic Kubowitz and Ott[3] assay (1943) utilizing the pyruvate to lactate reaction. In 1956, Wacker et al[4] described a procedure that followed a lactate to pyruvate reaction. The lactate to pyruvate reaction became the preferred reaction[5], even though the slower of the two, because of a wider linear range[6] and no pre-incubation requirement[7]. The present method follows the forward reaction and has been optimized for greater sensitivity and linearity as outlined by Gay et al.[8]

Principle
$$\text{L-Lactate} + \text{NAD+} \xrightarrow{\text{LD}} \text{Pyruvate} + \text{NADH} + \text{H+}$$

Lactate dehydrogenase catalyzes the oxidation of lactate to pyruvate with simultaneous reduction of NAD to NADH. The rate of NAD reduction can be measured as an increase in absorbance at 340nm. This rate is directly proportional to LD activity in serum.

Reagent Composition
After combining R1 and R2 the reagent contains: NAD 5.8 mM, L-Lactate 55 mM, Buffer pH 8.95. Non-reactive stabilizers and sodium azide (0.1%) as preservative.

Reagent Preparation
Reagents are supplied as ready to use liquids. To prepare a working reagent, mix 5 parts Buffer (R1) with 1 part Co-enzyme (R2).

Reagent Storage and Stability
Reagents are stable until stated expiration if stored as directed. If a single working reagent is required, prepare only the amount required to complete current day's testing. Discard remaining reagent after completion of testing. Protect from light. Avoid microbial contamination.

Precautions
1. This reagent is for *in vitro* diagnostic use only.
2. The reagents contain sodium azide (0.1%) as a preservative. Do not ingest. Avoid skin and eye contact. Sodium azide may react with lead and copper plumbing fixtures giving rise to explosive metal azides. Flush with large volumes of water when disposing of the reagent.
3. All specimens and controls should be handled in accordance with good laboratory practices using appropriate precautions as described in the CDC/NIH Manual, "Biosafety in Microbiological and Biomedical Laboratories," 2nd ed., 1988, HHS Publication No. (CDC) 88-8395.

Specimen Collection and Storage
1. Non-hemolyzed serum is recommended. Red cells contain large concentrations of LD.[5]
2. The serum should be removed from the clot promptly.
3. Samples should be assayed soon after collection. LD in serum is reported stable for two to three days at room temperature.[9]
4. Do not freeze or expose the serum to high temperatures (37°C) as this may inactivate thermolabile LD isoenzymes.[10]
5. Specimen collection should be carried out in accordance with NCCLS M29-T2.[11] No method can offer complete assurance that human blood samples will not transmit infection. Therefore, all samples should be considered potentially infectious.

Interferences
1. Certain drugs and substances affect LD activity. See Young, et al.[12]
2. Bilirubin to the level of 20 mg/dl has been found to exhibit negligible interference (≤ 5%) in this assay.
3. Hemolysis has been shown to significantly interfere with the assay at levels as low as 100 mg/dl.

Materials Provided
Lactate Dehydrogenase Buffer (R1) Reagent
Lactate Dehydrogenase Co-Enzyme (R2) Reagent

Materials Required but not Provided
1. Accurate pipetting devices. (1.0ml and 50ul)
2. Test tubes/rack
3. Timer. (To measure 30 second and one minute intervals.)
4. Heating bath or block (37°C).
5. Spectrophotometer able to read at 340 nm (UV).
6. Controls to monitor the validity of the reaction.

Test Procedure (Automated-General)

Wavelength:	340nm
Assay Type:	Kinetic
Sample/Reagent Ratio:	1:21
Reaction Direction:	Increasing
Temperature:	37°C
Lag Time:	30 seconds
Read Time:	60 seconds
Low Normal:	80 U/L
High Normal:	285 U/L

For technical assistance concerning this product, contact the manufacturer's Technical Service Department.

Test Procedure (Manual)
1. Prepare the working reagent as directed.
2. Pipette 1.0ml of reagent into appropriate tubes and pre-warm at 37°C for five minutes.
3. Zero spectrophotometer with water at 340nm.
4. Transfer 0.050 ml (50ul) of sample to reagent, mix and return to heating block.
5. After 30 seconds, read and record absorbance (A_1 Reading). Return tube to 37°C for one minute.
6. After exactly one minute, read and record absorbance (A_2 Reading).
7. The change in absorbance (A_2-A_1) multiplied by the factor 3376 (See Calculations) will yield results in U/L.

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Note: If the spectrophotometer being used is equipped with a temperature controlled cuvette, the reaction mixture may be left in the cuvette while the absorbance readings are taken.

Limitations

1. Hemolyzed serum will cause falsely elevated serum LD levels.
2. Samples that exceed the linearity limit (1000 U/L) should be diluted with an equal volume of saline and re-assayed. Multiply the results by two to compensate for the dilution.

Calibration

The procedure is standardized by means of the millimolar absorptivity of NADH taken as 6.22 at 340nm under the test conditions described.

Quality Control

The validity of the reaction should be monitored by use of control samples with known normal and abnormal LD values. These controls should be run at least with every working shift in which LD assays are performed. It is recommended that each laboratory establish their own frequency of control determination.

Calculation

One international Unit (U/L) is defined as the amount of enzyme that catalyzes the transformation of one micromole of substrate per minute.

$$IU/L = \frac{(A_2 - A_1) \times 1.050 \times 1000}{1 \times 6.22 \times .050\ ml} = (A_2 - A_1) \times 3376$$

Where:

(A_2-A_1) = Change in absorbance
1.050 = Total reaction volume in ml
1000 = Conversion of U/ml to U/L
1 = Light path in cm
6.22 = Millimolar absorptivity of NADH
0.050 = Sample volume in ml

Example: If initial reading (A_1) = 0.450
Final reading (A_2) = 0.480
(A_2-A_1) = 0.03
Then 0.03 x 3376 = 101 U/L

Note: For SI units (nkat/L), multiply result by 16.76.

Expected Values[5]

Male	50-166 U/L (30°C)	80-285 U/L (37°C)
Female	60-132 U/L (30°C)	103-227 U/L (37°C)

Due to a wide range of conditions (dietary, geographical, age, etc.) known to affect reference ranges, it is recommended that each laboratory establish its own reference range.

Performance

1. Assay: 0-1000 U/L. Samples that exceed 1000 U/L should be diluted with an equal volume of saline, re-assayed and results multiplied by two.
2. Correlation: Results obtained with this reagent (y) in 103 samples ranging in LD level from 80 to 540 U/L were compared with those obtained in the same samples using a dry-powder reagent (x) from Pointe Scientific, Inc. based on the same methodology. The correlation coefficient was found to be 0.994 with a regression equation of y=1.00x + 7.4 (Sy.x = 7.95).
3. Precision: Precision studies were performed following a modification of the guidelines contained in the NCCLS document EP5-T2.[12]

Within Run			Run to Run		
Mean	S.D.	C.V.%	Mean	S.D.	C.V.%
183	2.59	1.4	189	5.53	2.9
441	3.76	0.9	443	6.33	1.4

4. Sensitivity: The sensitivity for the Liquid LD reagent was investigated by reading the change in absorbance at 340nm for a deionized water sample, and serum samples with known LD activities. Ten replicates of each sample were performed. The results of this investigation indicated that on the analyzer used, the Liquid LD reagent showed little or no reagent drift on a zero sample. Under the reaction conditions described, a change in absorbance of 0.0001 was approximately equivalent to 1 U/L of LD activity.

References

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