

## APPENDIX

### INFORMATION ON LACTIC AND FORMIC ACIDS

In the present work, the author had <sup>used</sup> lactic and formic acids of varying concentrations to study the morphology of dislocation etch pits. Excellent account of properties of these acids are available in number of handbooks (e.g. Handbook of Chemistry and Physics, Weast, CRC, 57th ed. 1976 , Encyclopedia of Chemical Tech ; Kirth and Othmer, Vol. 10,12, 1967). The general information about these acids are presented here.

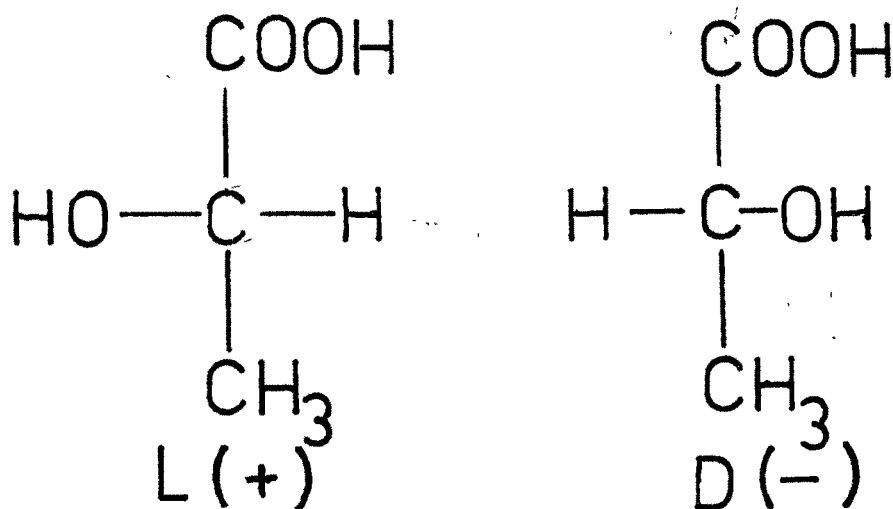
(1) Lactic Acid (Kirk and Othmer, 1967, Vol. 12, Page 172)

Lactic acid (2-hydroxypropionic acid,  $\alpha$ -hydroxy propionic acid),  $\text{CH}_3\text{CHOHCOOH}$ , the simplest hydroxyacid containing an asymmetric carbon atom, exists in two optically active forms and as a racemic mixture, all of which are water soluble colourless liquids at ordinary temperatures. This acid is widely distributed in nature. It is this extremely wide distribution which makes it interesting and important. Lactic acid is primary acid constituent of naturally soured milk (hence its name), and a normal constituent in the blood and muscle tissues of animals. Abnormally high lactic acid content has been observed in human blood in cases of pneumonia, tuberculosis, and heart failure.

Scheele discovered lactic acid in sour milk in 1780. The early work, aimed at identifying and characterizing the different lactic acids (the dextro and levo forms and the racemic mixture), was handicapped by their unfavourable physical properties. Being extremely soluble in both water and water-miscible organic solvents, the optical isomers of acid were obtained only with considerable difficulty.

Both optical isomers of lactic acid occur in nature but the commercial acid is usually the optically inactive form. Optically active acids have been prepared by direct fermentation under controlled conditions and also by the resolution of the racemic mixture through zinc ammonium salt or the salt with alkaloids, such as morphine.

The literature is confusing regarding the designation of the isomeric forms of lactic acid since the characters "d" and "l" have been used either to optical rotation or to configuration. The acid is frequently known as "Sarcrolactic" or "Paralactic" acid, the form occurring in blood, has a (+) rotation but L configuration. It is, therefore, correctly designated as L (+) - lactic acid and its enantiomorph, D(-) - lactic acid. The configurational relationships are illustrated by structures.



However, the salts of L(+) acid are levorotatory and the salts of D(-) acid are dextrorotatory. Table shows some properties of optical isomers.

TABLE - A

Properties of Lactic acid isomers

Optical form	M.P. °C	Rotation	Dissociation constant at 25°C
D(-)	52.8	- 2.6	-
L(+)	52.8	+ 2.6	-
racemic	16.8	inactive	$1.38 \times 10^{-4}$

Because of the ease with which lactic acid undergoes self-esterification when heated, it is difficult to determine boiling point at reduced pressures. The properties of aqueous solutions of lactic acid are particularly important

since the acid is usually encountered in this form. The composition of dilute solutions containing less than approximately 20% lactic acid corresponds to monomeric lactic acid and water. Solutions of higher concentrations, however, are more complex because of self-esterification to so-called poly lactic acids of various chain lengths. Lactic acid has a high viscosity and its specific gravity is 1.2060.

(2) Formic Acid (Kirk and Othmer, 1967, Vol. 10 Page 99)

Formic acid,  $\text{HCOOH}$  is the simplest of the carboxylic acids. Formic acid is a colourless, fuming liquid. It is irritating to eyes, nose, and throat and will cause burns and blisters when in contact with the skin. The principle use of formic acid is in leather and textile industries although it is also employed as an intermediate in the production of other chemicals. Its melting point is  $8.4^{\circ}\text{C}$  and density is 1.2202. Its dissociation constant,  $K$ , is  $1.765 \times 10^{-4}$ , approximately ten times the corresponding value for acetic acid.