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NASA TECH BRIEF

Ames Research Center

Computer System for Monitoring Radiorespirometry Data

A radiorespirometry–computer system has been developed which makes possible the monitoring of expired $^{14}CO_2$ breath patterns simultaneously from four small animals after they have been injected with carbon-14 substrates. The system also can be used to monitor expired carbon dioxide patterns. It has revealed significantly quantitative differences in oxidation patterns of glucose following such mild treatments of rats as a change in diet (20-hour fast) or as a change in environment (for example, increased gravity by centrifugation).

From an investigative as well as a diagnostic viewpoint, the technique of radiorespirometry offers many advantages, among which are: (1) Tests can be repeated on the same subject, and the subject can be his own control; as a result, data interpretation is less involved with pool size, compartmentalization, and recycling of the metabolic substrate. (2) The number of repetitive tests can be large since the substrate which is used is innocuous and easy to administer.

Combination of the radiorespirometry technique with an on-line computer system offers important additional advantages: (1) Automatic corrections of equipment noise, delay times, and flow distortion; (2) Rapid calculation of normalized specific activity values; (3) Improved accuracy by large increase in number of calculation operations; (4) Real-time display of data, as well as rapid (10 to 20 minutes) printout of specific activity curves and calculated data tables.

The radiorespirometry technique described briefly as follows is not significantly different from that in prevalent use. After injection with a ^{14}C-labeled substrate, such as ^{14}C-bicarbonate or ^{14}C-glucose, etc., animals are placed in small hemispherically-shaped metabolism cages. Respiratory gases from each of the four metabolism cages are transferred to a respirometry system for analysis of total CO_2 by infrared and analysis for $^{14}CO_2$ by an ionization chamber–electrometer. Analytical data from the respirometry systems are then processed by an on-line computer.

Prior to each test, electronic noise and voltage difference in each respirometry system is subtracted by the following calibration procedure: The output of the respirometry system at zero setting is recorded for 5 minutes while a CO_2-free carrier gas purges the system; the output is averaged by the computer and set to zero. A constant flow of calibrating gas ($^{14}CO_2/^{12}CO_2$) is introduced into the system and the output recorded for 5 minutes after peak output is reached; the output is averaged by the computer to build an internal calibration of mV-output *vs* concentration, which is used to calculate experimental outputs.

The analog outputs of the respirometers may be sent simultaneously to an analog tape recorder for permanent storage and to a small computer (4K memory) where the data are processed to give digital printout of $^{14}CO_2$, $^{12}CO_2$, percent recovery, and cumulative sum of CO_2 at 1-minute intervals. However, only one respirometry system can be processed at a time because of the slow teletype printout and the limited computer memory. Optionally, an intertie can be made with a time-sharing terminal to a large computer (32K memory) equipped with high-speed printout, visual display, and X-Y plotter; thus, the rapid computation of various models, peak time, constants, and other ratios can be made for four respirometry systems at one time. In this instance, the

(continued overleaf)

small computer becomes the data-acquisition console where data are sampled multiply and averaged at 1-minute intervals; the condensed data are fed to the large computer by an interrupt mode when the small computer memory is full. The tape recorder becomes an auxiliary output file as a backup in case of computer failure.

Note:

Requests for further information may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

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