HUMAN METABOLIC STUDIES: PINNACLE AND PERIL

M.A. ALLMAN and K.M. KINGHAM

Human nutrition studies are frequently criticised because of lack of control over the diets being fed. However, unlike animal work where a totally defined diet can be fed there are many barriers to this in humans. The best control is obtained when subjects are confined to a ward, observed 24 h per day and can only eat what is served to them. While such studies continue in the United States the high cost makes them prohibitive for Australia. The worst alternative is to advise subjects what to eat but to leave them to select, buy and prepare their own food and keep a food record. When faced with the task of assessing the difference between two diets differing only in the ratio of alpha-linolenic to linoleic acid a compromise between the two extremes was selected. Subjects would be supplied with all their food.

The first task was to construct the appropriate menus based on the dietary prescription. This was made difficult because the Australian Food Composition data do not have fatty acid data on computer. Investigators looking at amino acids, specific sugars or a nutrient such as folic acid will encounter the same problem. A computer program was constructed to complete this task. Some foods had no data on fatty acid content at all and had to be chemically analysed. A 12,000 kJ diet was constructed and the quantities of each food were proportionally increased and decreased according to the subjects energy requirements. A seven day menu cycle was selected for the two week stabilisation period and a 10 day menu cycle for the 42 days of the test diet. A master file of the quantities of food to be consumed by each individual on each of the 56 days was compiled for use in the study kitchen. A computer program was then generated to calculate the amount of each particular menu item that would be required each week and to cost it. It was obvious that one full time dietitian working on the study could not prepare all meals. The diet kitchen at a major teaching hospital, with facilities for blast freezing, was approached to make the evening meals to specifications. Gifts of bread, cereal, pasta and oils were made by a company. The next problem was the storage of these large amounts of food which were to feed 12 subjects for 8 weeks. Two domestic freezers provided only enough space for one week's supply so commercial freezer space was purchased. Perishable items such as milk, fruit and vegetables were purchased on a weekly basis by the dietitian and a visit made to the freezer facility to retrieve the week's meals.

While all food would be provided subjects were still free-living and in theory still free to consume any food they desired. It was decided that 30% of their meals would be consumed under supervision of a staff member. This translated to breakfast and lunch on the five weekdays. Lunch and two snacks were consumed away from the nutrition staff and subjects had all their food for the weekend packaged for collection on Friday night. All food on the two test diets was identical but for the fat composition of the muffins and for this reason they had to be consumed in the presence of study personnel. Each subject was provided with an individualised diary of all the food they were to consume for each of the 56 days of the study and asked to report and document any deviations. Maintaining close personal contact with subjects maximised compliance. The ratio of researchers to subjects was approximately one to three and all subjects were University students or graduates. Subjects did not substitute the meals provided with other foods there were only minor deviations from the prescribed menu e.g. one subject missed a fruit juice because his flatmate drank it and one subject failed to consume all the food one day because he was ill.

The major advantage of providing all food is that the two test diets are standardised for all nutrients not just those of greatest interest. This eliminates potentially confounding effects of other nutrients known and unknown e.g. fibre on cholesterol and vitamin C on platelet reactivity. The limiting factor is the cost including labour, food, utilities and storage but it is estimated to be only 10% that of maintaining subjects in a metabolic ward.

Human Nutrition Unit, Department of Biochemistry, University of Sydney, NSW 2006