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PROBLEMS IN THE ASSESSMENT OF NUTRIENT REQUIREMENTS

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Chairman's introduction

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The requirement for any given nutrient or for energy is the amount of that nutrient or energy which must be supplied in the diet to meet the needs of the normal healthy individual animal, higher or lower, given an otherwise completely adequate diet and in an environment compatible with good health. Thus, it is the amount of a nutrient that must be supplied in the diet to meet the net requirement. The net requirement is the quantity of a nutrient or of energy that should be absorbed by a normal healthy individual given a completely adequate diet in such an environment in order to meet its needs. The net requirement depends on the physiological state and the function considered: it will be for maintenance including the replacement of endogenous losses, and for the amounts needed in fulfilling growth and the desired productive and reproductive potential, but it may also need alteration to meet the common and the rarer stresses of daily existence. For farm animals it is the amount needed to meet a specified rate of growth, or a stated level of production, or for reproduction. In lower animals economic factors influence the net requirement.

As we shall hear, the requirement for nutrients can be influenced by the degree of microbial activity in the alimentary tract for through this agency there can be both enhancement and deduction in the nutrients absorbed. This is particularly so in ruminants.

As the serious shortages of available protein and energy both for lower animals and for man become resolved, vitamin and mineral, and in particular, trace element inadequacies may come to light as factors limiting production.

When we come to formulate the allowances necessary to meet the requirements we must provide safety margins to take into account variations in availability of nutrients, losses during manufacture, genetic variations and individual abnormalities or peculiarities and conditions that can influence — such as husbandry practices.

Short-term balance studies of actual intakes by man where economic circumstances do not restrain adequacy of intake may or may not give values reflecting the levels of intake to be found over longer periods. There may be within-week or within-season changes.

Protein constitutes the great bulk of the soft tissues of the body yet we are still unclear about requirements, more particularly in the case of man. The Ministry of Health (1964) publication, *Requirements of Man for Protein*, attempted to approach the problem by fixing a lower limit of requirement which would, as far as possible, be based upon the results of laboratory investigations and compared it with a higher limit based on observation of consumption of protein in situations where there was no reason to suppose a deficiency existed. Physiological requirements must be somewhere between these two limits and attempts should be made to narrow the gap of ignorance. In all considerations of protein it is assumed that the calorie intake is neither deficient nor excessive. This is important. The values assumed should obviously be related to persons who are neither obese nor unusually lean.

In the UK the biological value of the protein in the diet is assumed to be 80 or so with reference to the ideal protein of 100. The biological value relates to the use made of the absorbed amino acids and does not allow for losses in digestion. Correction of this is thus necessary in prescribing diets. The essential amino acids in the protein of mixed diets for adults in the UK are likely to be in excess of their requirements and in consequence a defect, if any, in the diet will not be in total protein.

Autret (1970) has set out for man his requirements for protein per head per day at retail level under three heads.

- (1) M, average requirements, national level, covering only 50% of the population.
- (2) P, average requirements + 20%, covering the requirements of 97.5% of the population.
- (3) O, objectives (qualitative and quantitative) ensuring a protein kcal/total kcal between 10 and 12% (see Cuthbertson, 1940, 1964).

For Western Europe these M, P and O figures are 60.3, 72 and 87 g: for the mainland of South East Asia they are 41.9, 50 and 57 g.

In the past it was assumed that man on a well-balanced dietary would inevitably have an abundance of all the trace elements and with little chance of deleterious excess. Nevertheless, iron deficiency is still the most widespread and frequently encountered, clinically-manifest, mineral deficiency in women. It appears to be as common today in women as it was 50 years ago. Its incidence even in developed countries is relatively high: 20-25% in recent Swedish, English and US studies (Underwood, 1970).

It would seem that we may have to revise our concepts of the best way to manage the supply of fluorine to prevent dental decay and to prevent osteoporosis if recent findings are well supported: 2 ppm in the drinking water is the maximum that can be tolerated by children without a significant and unsightly degree of mottling of the enamel and 1 ppm is considered the level of maximum health and maximum safety.

Yet a level of 4–6 ppm seems necessary to reduce the incidence of widespread osteoporosis and collapsed vertebrae in women (Underwood, 1970).

These are but examples of the complexity of the problem we are going to discuss.

I would remind members that a survey of the nutrient requirements of farm livestock has been published by the Agricultural Research Council:

- (1) Poultry (Agricultural Research Council, 1963),
- (2) Ruminants (Agricultural Research Council, 1965),
- (3) Pigs (Agricultural Research Council, 1967).

These are not presented in the form of practical allowances. Hence, in practice, safety margins will be allowed to take account of such factors as variations in availability of nutrients in different samples of feeding-stuffs, possible losses during manufacture and storage of food, breed and individuality of animals, environmental circumstances and standards of husbandry.

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Endogenous losses of nutrients

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Endogenous losses from the body occur via the urinary system, the skin, the lungs, the mammary gland (in lactating animals) and via the alimentary tract. It is comparatively easy to determine the extent of the losses by the first four routes but many complications occur when the alimentary tract is considered. These are to do with the secretions that enter the tract and their subsequent reabsorption, the continued desquamation of epithelial cells that occurs, and the flora and fauna that inhabit the tract. The result of these complications is that it is difficult or impossible to distinguish between endogenous and exogenous compounds or to form conclusions on whether the compounds reabsorbed confer less or greater nutritional benefits to the animal than the form in which they initially appeared in endogenous secretions.