

The biology of amino acid requirements: what do they mean and can we measure them?

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To answer this question we must start by considering the terminology that surrounds nutrient 'requirements' in general, and protein and amino acid requirements in particular (Reeds & Beckett, 1995). I believe that a number of the issues are clarified if we explicitly distinguish between amino acid needs (which are a function of growth and physiological status), dietary requirements (which are influenced by bioavailability and the efficiency of utilization) and recommended dietary allowances (which purportedly account for individual variation in both needs and requirements).

Amino acid needs

These needs can usefully be divided into those associated with net protein accretion (i.e. growth, fetal accretion and lactation) and those that are manifest in the non-growing non-reproductively-active adult; the so-called maintenance needs. I argue that the obligatory amino acid needs for growth are a simple function of protein deposition rate and the amino acid composition of the proteins deposited (Dewey *et al.* 1996). On this basis there seems little or no reason to suppose that this aspect of amino acid nutrition differs greatly among immature mammals. Indeed, most evidence supports this supposition.

However, quantifying maintenance amino acid needs poses both technical and conceptual problems. There are differences between estimates based on N and C balance trials, a subject of continuing argument (Millward & Rivers, 1988; Young *et al.* 1989; Millward, 1998; Young, 1998). As well as the possibility of technical explanations (Fuller & Garlick, 1994), real differences in amino acid-C and -N metabolism may explain at least part of the difference. In addition, consideration must be given to the role of amino acids as energy sources and the potential role of amino acids as precursors for the synthesis of compounds (e.g. creatine, glutathione, NO) of physiological importance (Reeds & Hutchens, 1994). Key examples include the maintenance of muscle neural and immune protection. This discussion highlights the important

role of non-essential and conditionally-essential amino acids.

Dietary requirement

In essence this term describes the quantities of amino acids that must be ingested to support the metabolic need, the question of bioavailability being of particular significance. In this regard it is important to note that recent work has shown that on one hand many proteins are digested with high efficiency (Mariott *et al.* 2000), but on the other hand that intestinal and hepatic metabolism can have highly-significant effects on both amino acid bioavailability and needs (Bertolo *et al.* 1998; Stoll *et al.* 1998). Data on the influence of the intestine must be considered in detail.

Recommended dietary allowance

The objective of this formulation of amino acid 'requirements' is to define recommendations for populations, and from a biological perspective the definition is dominated by considerations of individual variability in both need and requirement. Complete mechanistic understanding of individual variability is not yet forthcoming, even though there are good data to illustrate that this problem is substantial (Jones *et al.* 1956). Recent data in immature animals (Wray-Cahen *et al.* 1997) and adult human subjects (Fereday *et al.* 1998) should be considered in relation to the role of hormonal sensitivity of protein turnover.

In concluding, three critical areas of ignorance can be highlighted:

- (1) the factors that regulate intestinal amino acid metabolism, since it influences need, requirement and allowance;
- (2) the nutritional impact of the emerging role of amino acids as cellular regulators;
- (3) the nature of the processes and the underlying genetic factors that lead to quite large individual differences in the efficiency of amino acid utilization.

Amino acid requirements: Dietary amino acids: Recommended dietary allowance

References

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