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Abstract #225

Section: [Metabolism and Nutrition, Amino Acids](#)

Session: [Metabolism and Nutrition, Amino Acids](#)

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Day/Time: [Thursday 11:10–11:20](#)

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d-Methionine and d,l-hydroxy methionine: What is the metabolic cost of conversion of these enantiomers to l-methionine?

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This work aims to determine the energy cost of the conversion of L-methionine precursors (i.e., D-Met, D- and L-HMTBA) to L-Met. A framework representing the major biochemical pathways of nutrient metabolism was developed by van Milgen (2002), allowing quantification of the energy efficiencies of different nutritional scenarios. Using the concepts developed in this model, the theoretical energy costs of the conversion of D-Met, D-HMTBA, and L-HMTBA to L-Met were calculated. These enzymatic conversions involve oxidases (D-AAOX and L-HAOX) or a dehydrogenase (D-HADH) and result in the formation of a common intermediate, α -keto-methylthio-butanoic acid (KMB). The conversion of D-Met to KMB also results in the release of the amine group ($-\text{NH}_2$). The transamination of KMB to L-Met requires an amine group from another amino acid. If this amine group comes from protein given in excess of protein deposition, less energy will be excreted as urea or as uric acid. The ME value of D-Met would be equal to that of L-Met because the amine group released in the production of KMB can be reused for its transamination to L-Met. Considering the gross energy values of D,L-Met, D,L-HMTBA, urea, and uric acid are respectively 3522, 3366, 635, and 1926 kJ/mol. For 1 mol of D,L -

HMBTA, the excretion of 0.5 mol urea or 0.25 mol uric acid is avoided. Consequently, the ME-to-GE ratio for D,L-HMBTA is $(3366 + 630 \times 0.5)/3366 = 109\%$ in mammals and $(3366 + 1926 \times 0.25)/3366 = 114\%$ in birds. The energy efficiencies of using ME also differ for the enantiomers of L-Met. The oxidative conversion of D-Met and L-HMTBA to KMB leads to the formation of hydrogen peroxide. This H_2O_2 can be catabolized through the oxidation of reduced glutathione (GSH) to oxidized glutathione (GSSG). The reduction of GSSG back to GSH requires 1 NADPH, which is equivalent to 3 ATP. Because 74.2 kJ of glucose is required to synthesize 1 ATP, the NE-to-ME ratio (relative to that of L-Met) can be calculated as $(3522 - 3 \times 74.2)/3522 = 92\%$ for D-Met and as $((3366 + 630 \times 0.5) - 3 \times 74.2)/(3366 + 630 \times 0.5) = 94\%$ for L-HMTBA. The conversion of D-HMTBA to KMB yields 1 NADH, which is equivalent to a savings of 3 ATP. The relative NE-to-ME ratio is therefore $((3366 + 630 \times 0.5) + 3 \times 74.2)/(3366 + 630 \times 0.5) = 106\%$ for D-HMTBA. Consequently the NE-to-ME ratios (relative to that L-Met) are 96% and 100% for D,L-Met and D,L-HMTBA, respectively. Summarizing, compared with the energy values of L-Met, D,L-Met has an ME value of 100% and an NE value of 96%. For D,L-HMTBA these values are 114% and 100% for ME and NE, respectively.

Key Words: methionine, hydroxy-methionine, energy

