How Nutrition Fuels Human Space Flight

Space Nutrition

Nutrient Requirements
- Energy
- CHO (fiber), Fat, Protein
- Fat-soluble vitamins
- Water-soluble vitamins
- Minerals
- Fluid

Countermeasures
- Energy
- Amino acids
- Protein
- Sodium
- Fatty acids
- Antioxidants
- Other
- Bisphosphonates
- KCitrate
- Other Meds
- Exercise
- Other

Vehicle/Mission
- Location
- Food System
- Radiation
- EVA
- Schedule

Systems
- Bone
- Muscle
- Cardio
- Fluid/Electrolyte
- Hematology
- Neurovestibular
- Endocrine
- GI
- BHP
- Vision

Operations Research
- Radiation
- EVA
- Schedule
Zwart et al., AJCN, 2013
800 IU vitamin D/day will maintain vitamin D status.
Enzymes
- Proteins, amino acid strings
- Assembled from amino acids based on “blueprints”

Enzyme Polymorphisms
- poly = multiple, “morph” = forms
- For many (all?) enzymes, there are small differences in blueprints across the population (e.g., blood types)

Follow-on study:
- Five 1C polymorphisms
- Expanded biochemistry/metabolomics
- Vision and related medical data
- n = 70/72 ISS astronauts
This line of research may ultimately:
Inform risks of space flight
Inform research/countermeasure options
Have broad application in health and medicine
Calcium Isotopes

$^{40}\text{Ca}$ $^{42}\text{Ca}$ $^{44}\text{Ca}$ $^{46}\text{Ca}$ $^{48}\text{Ca}$ $^{43}\text{Ca}$ $^{43}\text{Ca}$

0.187% 0.1% 0.187% 0.647% 96.941%

Bone formation favors light Ca isotopes

Higher $\delta^{44}\text{Ca} = "heavier"$

Lower $\delta^{44}\text{Ca} = "lighter"$

No isotope discrimination during bone resorption

30-d bed rest: -0.25 ± 0.07%

119-d bed rest: -1.36 ± 0.38%

DXA 119-d bed rest: -1.5 ± 1.0%