FOOD AND NUTRITION FOR THE MOON BASE: WHAT WE HAVE LEARNED IN 45 YEARS OF SPACE FLIGHT

Helen W. Lane, PhD, RD
Vickie Kloeris, MS
Michele Perchonok, PhD
Sara Zwart, PhD
Scott M Smith, PhD
Author Biographies

Helen Lane, Ph.D., R.D., is Manager of University Research and Affairs Office, NASA, Johnson Space Center, Houston, TX and directed the nutritional biochemistry laboratory from 1989 to 1994 and director of the Biomedical and Research Branch from 1990-1994.

Vickie Kloeris, M.S., is a food scientist and Manager of the International Space Station Food System. She has been working with space food systems at the Johnson Space Center for twenty-one years.

Michele Perchonok, Ph.D., is a food scientist and Manager of the Space Food Systems Laboratory, Manager of the Shuttle Food System, and the Advanced Food Technology Lead. She has been working at the NASA Johnson Space Center Houston, TX since 2000.

Sara Zwart, Ph.D., is a research scientist in the Nutritional Biochemistry Laboratory at the NASA/Johnson Space Center Houston, TX.

Scott M Smith, Ph.D., is Senior Nutritionist and Manager for Nutritional Biochemistry at the NASA Johnson Space Center. He has been involved in studies of nutrition and physiology during space flight since 1992.
INTRODUCTION – HISTORY OF HUMAN SPACE FLIGHT – FOOD AND NUTRITION

The United States has a new human space flight mission—to return to the Moon, this time to establish an outpost to continue research there and develop our ability to send humans to Mars and bring them back in good health. The Apollo missions were the first human expeditions to the Moon. Only 2 crew members landed on the lunar surface on each Apollo mission, and they spent a maximum of 72 hours there. Future trips will have at least 4 crew members, and the initial trips will include several days of surface activity. Eventually, these short (sortie) missions will extend to longer lunar surface times, on the order of weeks. Thus, the challenges of meeting the food and nutritional needs of crew members at a lunar outpost will be significantly different from those during the early Apollo missions.

The U.S. has had humans in space beginning in 1961 with increasing lengths of time in space flight (Table 1). Throughout these flights, the areas of particular concern for nutrition are body mass, bone health, and radiation protection. The development and refinement of the food systems over the last 30 years are discussed, as well as the plans for both the sortie and lunar

The following 2 articles briefly review what we know today about food and nutrition for space travelers and relate this knowledge to our planned human flights back to the Moon.
Table 1. Summary of the US human space flight programs.

<table>
<thead>
<tr>
<th>Year</th>
<th>Human Space Flight Program</th>
<th>Flight Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1963</td>
<td>Mercury</td>
<td>15 min-34 hours</td>
</tr>
<tr>
<td>1965-1966</td>
<td>Gemini</td>
<td>5 hours-14 days</td>
</tr>
<tr>
<td>1968-1972</td>
<td>Apollo</td>
<td>5-13 days</td>
</tr>
<tr>
<td>1973-1974</td>
<td>Skylab Space Station</td>
<td>28,59, and 84 days</td>
</tr>
<tr>
<td>1981-present</td>
<td>Space Shuttle</td>
<td>4-15 days</td>
</tr>
<tr>
<td>1995-1998</td>
<td>Shuttle –Mir Space Station</td>
<td>4-6 months</td>
</tr>
<tr>
<td>2000-present</td>
<td>International Space Station</td>
<td>5-7 months</td>
</tr>
</tbody>
</table>
REFERENCES

Figure 1. Illustration of Lunar Base