FOOD SERVICE AND NUTRITIONAL NEEDS

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I really did not come here to pontificate on the food system, although being a former member of the crew I will wind up doing so no doubt. Some of the people here know how the food system has developed and how it got to where it is now. It struck me that on the very first few flights in the manned space program the food system presented no problem whatsoever because there did not have to be one when Alan Shepard was up for 15 minutes and Gus Grissom after him, and even John Glenn, when he flew for 5 hours. It really was not a big deal, but from then on, as we began to fly for 8 hours and then 24 hours and then 32 hours and then 8 days or bust on Gemini, it began to be a big deal. The name of the game has been nutrition and packaging all the way along. Although nutrition was the unknown area, packaging has been a big problem. We have had our nutritional problems and from the Skylab point of view I can reminisce about some of those. The original Skylab food plan was to give all the astronauts 2400 calories a day whether they wanted it or not. This resulted in Deke Slayton writing his famous memo saying that his crews were not goose livers and he would not stand to see them stuffed. From there we got into the plan where each of us ate test meals for two six-day periods, as I recall, and every scrap that we ate and every scrap that we left was measured. They figured out what our caloric requirements were on the ground, subtracted 300 calories from that and then gave us that package for Skylab. It was that or nothing. The potassium, calcium, sodium, magnesium and a number of other things were all rigidly specified. We had pills to eat each day should we fail to consume some of our food, which we often did if it was asparagus, peas, or some of those favorite things. The next day we would report to the ground, "I didn't eat my peas." "Tomorrow you take two white pills and one brown pill and you'll be all right."

On Apollo we had the famous potassium flap. I believe it was Apollo 15 with Dave Scott, Al Worden, and Jim Erwin. They came back from a very vigorous pair of excursions on the surface of the Moon substantially dehydrated, and they had some cardiac arrythmia during the return flight to Earth, which scared everybody a bit. They had their body potassium estimated after they got back and it was like a 15 percent loss on a 10- or 11-day flight. Potassium was the buzz word for awhile. John Young complains to this day that the cause of his diarrhea and stomach upset on Apollo 16 was all the potassium that was put in the orange juice. I guess bananas were not ready yet.

So there have been things like that as we went from tubes to bags to cans and dealt with crumbs and spills and all the packaging constraints, and now on the Shuttle we have a system that works. The food is nicely packaged and there is a good selection. The crew is still edging toward a bit more individual selection, rather than a standard menu, but on a 7-day flight you can pretty well eat what is available in the cafeteria and it works very well.

The difficulty is that as we go into the Space Station world, the cost, effort, hardware, food trash, and food waste that the food service system will generate (which is quite tolerable on a 7-day mission), probably will be intolerable on a 90-day Space Station mission. The challenge for Space Station, and this is strictly a personal guess, will not be the nutrition. There are certainly some nuances; we are in a closed system, the food you bring is what you get, and we are going to have to be careful not to forget any trace elements, vitamins, and the nutritional things that we need. However, by and large, we understand that the needs of the human being in weightlessness are at least qualitatively much the same as they are on the ground.

The challenge in the food service supply is not so much packaging but systems engineering. It is a very interesting system but the big constraints are in the supply pipeline. The average owner of a four-star restaurant can go out and get supplies from wherever he gets them any time he wants; he can use all the water he wants in his food preparation and his cleanup. He is not constrained, except for cost constraints, of course. The Space Station will be extremely limited in the weight and the volume of supply that is allowed to be brought up to it because each launch will cost $100 million and one space Shuttle worth of cargo, which may approach 60,000 pounds, has to resupply everything including new crewmen. We are going to have to be very, very careful. For example, in the clothing system it has been estimated that if we do not get smart and figure out some way to wash the clothes or clean them and reuse them in flight, there will be a 3,000-pound weight bogey when the Shuttle comes up to resupply every 90 days. That is very, very expensive clothing, no matter where you get it. The same analogy applies to the food system. That is why we have to think about bulk packaging and cooking in a meal style rather than individual packaging.

These constraints impose a very interesting new set of tradeoffs. For one thing we have been able to control individual nutrition rather accurately in a system that packages each food item individually and gives a crewman a combination of those items which meet his nutritional requirements. This system is available today. Of course, Deke Slayton was right; you do not have to eat the food. Some of it has come back uneaten, but, again, during seven days that is not a big deal. One of the things we want to figure out is how big a deal it is in 90 days. However, if we go to group meals we will have less control because we will not have control over the portion size. It will be more like at home where you are presented with good nourishing food and a well-balanced diet but you do not have to eat it if you do not want to.

From an efficiency standpoint, will there be less waste if we bring up the food in bulk and cook it and allow the crew to waste 20 percent of it as plate waste? Should we go back to individual packaging, or is there some combination of the two, such as bulk cooking and serving into individual packages in measured amounts? If there is such a combination, which is certainly feasible in principle, what is the capital cost, weight of the equipment, power drainage, and all the other factors that have to be considered in a tradeoff study so that we can figure out what to do?

I suppose palatability would be affected by these choices. It certainly would be affected by the choice of eating what is on a menu or selecting individual items. At this point, I want to mention our experience with the German potato salad. The way we did it at Skylab was to have rigidly specified diets. We

were allowed individual choice during the menu selection phase but the individual items were then balanced to produce set meals. We ate the same breakfast every sixth day. We had a six-day cycle, so the food was very well set, but there was a pantry--a big locker downstairs--in which excess food was stored to provide for contingencies such as spoilage. There was a little candy that we could eat if we wanted to, there was extra coffee and there was some German potato salad. The German potato salad was quite spicy, and on the ground most of us did not select it very often so it did not occur in our meals. When we got up there we found that the very best thing in the world was German potato salad, and I must shamefully confess that by the end of Skylab 1, our flight, there was no German potato salad left in the pantry. The second and third crews just had to make do with what they selected. Of course, they could not change their minds because the food items were launched in Skylab and they were up there waiting for them--the asparagus, the green peas and the irradiated bread. Even with peanut butter it was pretty bad stuff. I am not knocking the food system, a lot of the food was very good. Once the missions proceeded, we began to exercise more and finally had a little bit of a breakthrough from the medical experimenters who agreed that yes, if the crew was hungry and they did not want to eat just candy, they could eat extra nourishment, extra protein, extra carbohydrate and extra fat. The upshot of this was that the third crew, which was up three times as long as the first crew came back with only about one-third the weight loss, stronger in the lower extremities, and with less muscle loss. Their caloric intake per day had increased.

Bill Thornton had a wonderful chart which showed the weight loss as a function of time related to the nutritional input in calories per pound. It is a straight line across the three missions, with the last one being very close to baseline. This is why I say that the nutritional environment in weightlessness is not quite as strange as we thought it was when we embarked on the space program.

It is a new ball game, a very interesting ball game and a very challenging systems engineering job. Creative contributions will be required. We need to solve the tradeoffs and give the crew a sense of control over their destiny in terms of being able to modify their diet, even if it is only adding condiments or changing the day's menu a little bit. I know, from having been up there, that one way to keep the crew off your back is to dump the problem on their shoulders. They will be much more cooperative and will have a better time.