Rationale and Guidelines for the Space Health Contest

Revision: 2023.1.0 11/15/22

Introduction

The contest concept is to develop individualized food technologies with the potential to reduce adverse reactions to space radiation and other conditions of deep space flight. Analog missions are offered by Mars-Moon Astronautics Academy and Research Science (MMAARS, Inc.) to the contest winners of " ." The winners will present a plan to conduct prior to and during their Earth analog mission. Their food, nutrition, and nutrient timing plans will be consistent with the GOALS following.

Background

Multiple investigations conducted by NASA's Nutritional Countermeasures (NCM) Branch at the Johnson Space Flight Center have identified issues regarding the health of International Space Station (ISS) astronaut crews. The contest concept is to develop individualized food technologies with the potential to reduce adverse reactions to space radiation and other conditions of deep space flight. Analyses of nutrition and metabolic data have identified factors correlated with Spaceflight Associated Neuro-ocular Syndrome (SANS) and other conditions. NASA has identified tissue mitochondrial dysfunction and insulin resistance in astronauts which may require modification of spaceflight nutrition recommendations. Currently, NASA's nutrition guidelines for astronauts remain based on the 1980 USDA nutrition guidelines adopted for the Space Shuttle program. These guidelines include high carbohydrate content (50-55% calories) and minimal fats and proteins, and about 2700 daily calories.

Insulin resistance, which involves cells' resistance to importing sugar due to sugar saturation in the cells, seems to be a predisposing condition for modern health issues and susceptibility to viruses. Based on typical Earth diets similar to NASA guidelines research indicates insulin resistance often begins prior to space flight and is synonymous with metabolic syndrome. Another predisposing condition to insulin resistance recently identified is electrolyte imbalance in the bodily fluids. The consequences of metabolic syndrome/insulin resistance and nutrition countermeasures are described by Dr. Paul Mason of Sydney, Australia, at https://youtu.be/LRHir1k9jmE and others.

A recently reported study of 24 hr shift workers (the Healthy Heroes Randomized Control Trial) demonstrated the feasibility of time-restricted eating and impacts on cardiometabolic health https://pubmed.ncbi.nlm.nih.gov/36198291/ The detailed description of the methods of this trial is linked here: https://clinicaltrials.gov/ct2/show/NCT03533023 . Dr. Jason Fung of Toronto has shown that intermittent fasting, or "time-restricted eating," helps address metabolic syndrome. For mild conditions or maintenance, Dr. Fung recommends intermittent fasting 16-18 hours per 24-hour day. Type 2 diabetes, a common outcome of metabolic syndrome, in advanced cases is reversable by fasting and carbohydrate restriction. For milder conditions, there is support for diets that combine low carbohydrate, suitable fats, and moderate protein intake. Examples are variants of mildly "ketogenic" nutrition plans, such as Mediterranean, South Beach and Paleo. The addition of time restricted feeding seems to help address metabolic disorders by enhancing natural recovery systems. Metabolic flexibility may also enhance resistance to stressors such as radiation, chemical, and others present both in space and on Earth. Nutrition and behavioral changes that improve health enough to survive on Mars can also improve health for those who stay on Earth.

Contest Themes

Title: "Blueprint a Healthy Lifespan for Earth and Mars"

How would changes to food selection, nutrition, and nutrient timing promote a healthy lifespan?

The Challenge

Describe in a white paper the rationale and plan for food, nutrition, nutrient timing to promote optimal health and healthy lifespan.

Include in the white paper the following elements:

- Prior to a MMAARS analog mission, a 30-day study using the proposed diet plan to maintain or restore metabolic health
- Markers used to indicate initial and final measures of metabolic health or syndrome
- Explanation of how the markers determine the effectiveness of the design study
- A food diary with name of food, source, quantity by volume or weight, and how prepared (for example, raw or cooked)
- Time of meals and intervals of fasting and feeding, including daily and prolonged intervals
- Complementary interventions such as exercise, meditation and socialization
- Environment on earth and space

Preparation

MMAARS medical personnel will conduct a broad panel of tests at the beginning and end of the on-site study to evaluate the presence and progression or remission of conditions of insulin resistance/metabolic syndrome/mitochondrial stress. The winning contestant(s) will evaluate the improvement of these markers over the duration of their analog mission and in mission follow-up.

Contestants should allow for their known food intolerances and allergies but only keep a confidential list of medical prescriptions needed throughout the study and analog mission period.

Goals

1. Improve the health markers of analog mission participants.

2. Identify and recommend markers for extended lifespan.

Winning Contestants will:

- Be awarded scholarships in an introductory analog mission subject to meeting MMAARS medical standards.
- State why they expect their metabolic health to be improved using the markers they propose
- Implement their full plan and agree to provide their metabolic data to the MMAARS medical staff with a signed HIPAA release.
- Evaluate their 30-day plan as part of a longer 90-day evaluation they may conduct at their own initiative. (Studies show that 90 days tend to be necessary to reduce or eliminate insulin resistance).

Design and Development Guidelines

White Paper Titles

Print as the Contest title: “Blueprint a Healthy Lifespan for Earth and Mars”

Print your own title under the Contest title.

White Paper Content

Provide these sections:

Abstract

Introduction

Background

Plan

Expected results of metabolic monitoring

Conclusions

Background section guidance:

- How would you describe the basic benefits claimed for your food, nutrition, and fasting plan, and why?

- How does mitochondrial stress from common exposures on earth (e.g., processed foods including seed oils, fructose, sucrose, pesticides, dissolved metals, food toxins) affect your metabolic health and ability to respond to your food, nutrition, and fasting plan?

- How does mitochondrial stress connect to insulin resistance and metabolic syndrome? Give an estimate (none, some, many) of these injurious substances in the foods you have commonly consumed prior to implementing the plan.

- Would you expect the genetic/mitochondrial damage from space ionizing radiation to be reduced or eliminated by your plan? and Why?

Plan section guidance:

- Address the nutrition components listed below and how these components address the pre-existing metabolic disorder, if any, or maintain good metabolic health. List each component both by percentage of total and caloric content (proteins, fats, carbohydrates). See the Table below.
- Specify the sources (processed and/or fresh, grown on-board) of the food.
- Specify types of fats and proteins such as insects and synthetic proteins as well as 3D printed foods (from stem cells), plant extracts, and perhaps 3D printed plant extracts.
- Include estimates regarding taste (such as the six Ayurvedic basic tastes), shelf life, packaging, sterilization, aesthetics: appearance, etc
- Provide a detailed food, nutrition and fasting plan for the 3-month duration of the study. To simplify your paper, you may prepare a one- or two-week repeating plan

Table 1. Nutrient description and ranges (low% -high%)

- Percentage of proteins (all kinds)
- Percentage of Fats (all kinds)

- Percentage of Carbohydrates (all kinds)
- Carbohydrates classified by Glycemic Index (GI)
    - High GI: 70 and higher: sugars, starches
    - Medium GI: 56 to 69: potatoes, corn, white rice
    - Low GI (1 to 55): fruits, vegetables, nuts, beans, resistant starches
- Glycemic load (GL) Dietary Fiber (indigestible carbohydrates)
    - Soluble
    - Insoluble
- Micronutrients and supplementation
    - Vitamins
    - Minerals
    - Probiotics and prebiotics

Food intake interval possibilities

- Intermittent fasting
- Alternate day fasting
- Prolonged fasting

White Paper Requirements

Generate the white paper in Microsoft Word or equivalent and submit electronically in pdf format, properly formatted as if it were a paper document.

Paper guidelines:

1. All papers must be double-spaced on a 8 ½" x 11" page with 1" margins on all sides. Use 12-point Times New Roman font.

2. Paper is limited to 5-20 pages. This does not include the title, table of contents, abstract, appendices or references pages. Appendices are limited to 7 pages maximum.

3. The paper pages must be numbered consecutively beginning with the Introduction. Diagrams and tables may be included either within the paper or as part of the Appendices.

4. In general, the contents of the paper shall be organized as follows:

    a. *Title page:* Include the title and your title. Your title should consist of the minimum number of keywords necessary to portray accurately the contents of the paper. Reader interest is stimulated by a well-chosen title. The author's name must **NOT** appear on the title page, nor should any other persons or schools.

    b. *Table of Contents:* The table of contents should consist of a list of the parts of the paper and the page numbers, in order in which they occur.

    c. *Abstract:* The abstract should not describe the paper, but should give, in brief, the essential facts of its contents; for example, a brief of the problem or objective and a concise summary of the results or conclusion, touching upon methods or other details

only if they are unique or if they are of some particular significance. The abstract should be no longer than 100 words.

d. *Introduction:* The introductions should lead to the development of the subject so that the reader may obtain a clear understanding of the significance of the content, data presented, and/or conclusion. This can often be done by briefly giving the state of the art as background and then by bringing out the added advantages of the method of approach and emphasizing the importance of the results or conclusions.

e. *Background:* The main argument is carried out, complete with supporting references. The argument should proceed in a logical sequence according to a prepared outline. The writing should be in the third person. Support data and results can be presented most effectively as graphs, charts, or tables.

    i. Standard graphical symbols and abbreviations should be used on all drawings. Well- known abbreviations may be used in the text but should be defined where used the first time followed by the abbreviation in parentheses. Generally, the use of abbreviations should be confined to tables and illustrations.

    ii. Illustrations and tables should supplement, not duplicate, text materials. Likewise, they should complement, not duplicate, each other.

f. *Plan:* Provide all information as outlined above.

g. *Results: Expected* results of metabolic monitoring

h. *Conclusions:* The conclusions are often considered the most important part of a paper. They should be stated concisely in a separate section at the end of the paper. If there are three or more conclusions, better emphasis can be obtained by numbering or labeling each conclusion and setting it off in a separate paragraph.

i. *Tables:* Generally, each table should be typed on a separate sheet in an appendix and numbered consecutively using Roman numerals: Table I, Table II. However, they can be inserted as part of the main body. Small tabulations or listings may be made in the text where necessary for continuity. Each table should be titled by giving the brief description as a heading following the table number at the top. Ditto marks should not be used in tabled data, but brackets may be used to group information on several lines.

j. *Figures:* Figures should be numbered consecutively using Arabic numerals: Figure 1; Figure 2, etc. Three types of figures may be used: photographs, biochemical pathways, and line drawings. The reading material on illustrations should be kept to a minimum. In short, the reading material should be included in the captions. Portions of the illustrations may be identified by letters and explained in the captions. Whenever feasible in graphs, several trend lines or regression curves should be combined on the same coordinates. Their identifying letters or numbers should be in clear spaces between cross section lines. Readers generally prefer having the figures distributed through the paper, although it is also permissible to bind them together at the end in an appendix.

k. *Appendices:* There may be no more than 7 pages of appendices. Detailed biochemical pathways, development of nutrition sub-components in tables and examples, which are subordinate to the main argument in the body of the paper, and not essential to

following the argument, should be treated in the appendices. Main graphs as they are developed should be numbered consecutively. The graphs, figures, and tables in the Appendices should be numbered consecutively, following the numbers used for the graphs, figures, and tables in the text (such as, if table IV were last in the text, table V would be first in the Appendices.)

l. *References:* To enable the reader to consult important works used by the author incidental to the preparation of the paper and other related literature that might be helpful, a suitable reference list should be appended. References should be numbered consecutively. Examples are shown below:

Formatting Examples:

A related periodical: R.N. Hall, "Power Rectifiers and transformers," Proc. IRE, Vol0, pp. 1515-1518, November 1952.

For a book: W.A. Edison, "Vacuum Tube Oscillators," John Wiley and Sons,

Inc., New York, New York, pp. 170-171, 1948.

A related article: B. Lawrence, B.H. Weil, and M.H. Graham, "Making online

search available in an industrial research environment," Journal of

the American Society for Information Science, pp. 364-369, Nov- Dec. 1974.

YouTube presentations:

Jason Fung, Published on 3/5/17, YouTube Video “Jason Fung: “The Complete Guide to Fasting (& how to burn fat)”. https://youtu.be/n3dwizlGaRI.