EFFECT OF PROCESSING AND SUBSEQUENT STORAGE ON NUTRITION

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OBJECTIVE

➢ To determine the effects of thermal processing, freeze drying, irradiation, and storage time on the nutritional content of food
➢ To evaluate the nutritional content of the food items currently used on the International Space Station and Shuttle
➢ To establish the need to institute countermeasures

(BACKGROUND

Food products for space feeding systems are processed to commercial standards. While shelf-stability is the most effective food preservation process, it affects vitamin and protein quality. The dehydration process has the smallest impact on nutrients. Micronutrient stability is dependent upon the composite macronutrients matrix. A kinetic model only provides an estimate of the remaining nutritional content. It is difficult to extrapolate between systems. Food Composition Database does not take into account the effects of processing.

JUSTIFICATION

➢ Food with a 3-5 year shelf-life will be required for a mission to Mars
➢ Nutrient loss during processing and subsequent storage can be significant
➢ Nutrition requirements are delivered via the food system
➢ The quantity of nutrients, e.g. vitamins, at consumption is currently unknown
➢ Nutrients play a vital role in facilitating the capability of astronauts to tolerate physiological changes
➢ Nutritional deficiencies increase, physiology changes gain importance

DELIVERABLES

➢ Conduct a literature review to better understand the potential effects of retorting, freeze drying and irradiation on nutrient loss
➢ Determine the effect of processing on representative flight foods and products by comparing the calculated nutrition to the actual nutrition one month after processing
➢ Determine the effect of subsequent storage on nutrition by comparing the one month nutrition analysis results with those at 1 year and 3 years
➢ Determine the capability of the current food system to provide adequate nutrition for long duration missions

Exploring COUNTERMEASURES

➢ Optimization of process, packaging, and storage conditions for nutrient retention
➢ Exploration of alternative sterilization methods
➢ Maximization of available nutrients by reformulation using ingredients with dense intrinsic nutrients
➢ Treatments with food additives to provide nutrients, e.g. antioxidants
➢ Fortification with stable nutrient forms, e.g. encapsulation, chelating, analogs, etc.

RESEARCH PROTOCOL

➢ Ten to twelve processed food items will be selected per year for five years
➢ Nutritional profile will be determined:
  - 1 month after processing
  - 1 year after processing
  - 3 years after processing
➢ Comparing:
  - calculated vs. analysis
  - 1 month vs. 1 yr vs. 3yr
➢ Until a need for countermeasures is established

REFERENCES

Nutrition Requirements, Standards, and Operating Guides for Extravehicular Mission, Biochemical Nutrition Laboratory, Human Adaptation and Countermeasures Office, Space Station栖居, Biochemical Division, NASA, December 2005
Bowman BA, Russell RM. Present Knowledge in Nutrition. ILSI Press 2001
http://www.nal.usda.gov/fnic/foodcomp/cgi-bin/list_nut_edit.pl
http://www.esha.com

Effect of Processing on Nutrition

Effect of Subsequent Storage on Nutrition

Nutrient changes in bioavailability due to:
- Thermal processing
- Photochemical reaction
- Pesticide formation
- Decomposition

Determination determined by:
- Biochemical composition, e.g. crystalline & amorphous structure
- Oxidation & thermodynamic state of the water
- Environmental factors, e.g. moisture, gases, temperature
- Barrier provided by packaging