

AWARD NUMBER: W81XWH-18-2-0021

TITLE: Optimizing Protein Quantity, Quality and Combat Rations Delivery Systems

PRINCIPAL INVESTIGATOR: Army A. Ferrando, PhD

CONTRACTING ORGANIZATION: University of Arkansas for Medical Sciences
Little Rock, AR 72205

REPORT DATE: July 2019

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE*Form Approved*
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE July 2019		2. REPORT TYPE Annual Report		3. DATES COVERED 1 Jul 2018 - 30 Jun 2019	
4. TITLE AND SUBTITLE Warfighter Recovery Nutrition: A Strategic Partnership with USARIEM to Optimize Protein Quality, Quality and Combat Ration Delivery Systems				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER W81XWH-18-2-0021	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Arny A. Ferrando, PhD E-Mail: aferrando@uams.edu				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Arkansas for Medical Sciences 4301 W Markham St, Slot 812 Little Rock, Arkansas 72205-7101				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The overarching goal of this strategic, collaborative plan is to provide evidence-based nutritional recommendations for the development of new combat ration food products designed to maintain performance during SUSOPS. The following specific aims address the proposed studies within this plan: #1. Determine resting and post-resistance exercise skeletal muscle and whole body protein kinetic responses to graded EAA intake (Study 1); #2. Determine resting and post-resistance exercise skeletal muscle and whole body protein kinetics responses to various formats of EAA intake in response to acute, moderate energy deficit (Study 2); #3. Determine the effects of various protein-containing food matrices on skeletal muscle and whole body protein kinetics with combined military-type activities and acute, moderate energy deficit (Study 3); #4. Test the ration prototype during a 5-d simulated SUSOPS (Study 4) on whole-body protein kinetics and performance outcomes; and #5. Validate the efficacy of a protein-containing combat ration during a "real-world" training exercise (Study 5). There is a critical need for effective and feasible interventions that sustain and optimize Warfighter health and performance during real-world operations. Development of combat ration items for optimal protein delivery will spare muscle and whole body protein and promote recovery from operational stress.					
15. SUBJECT TERMS Protein turnover, muscle, essential amino acids (EAA), energy deficit, exercise, net protein balance, protein synthesis.					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			USAMRMC
Unclassified	Unclassified	Unclassified	Unclassified	8	19b. TELEPHONE NUMBER (include area code)

Table of Contents

Front Cover	1
Standard Form (SF 298).....	2
Table of Contents	3
Introduction	4
Keywords	4
Accomplishments	4
Impact	4
Changes/Problems	5
Products.....	5
Participants	6
Other Collaborating Organizations	7
Special Reporting Requirements.....	7
Appendices	8
Additional Notes	8

1. INTRODUCTION:

The primary goal of Study 1 is to characterize the effects of graded EAA intakes on resting and post-resistance exercise skeletal muscle and whole-body protein kinetics after a 5-d, 20% energy deficit.

2. KEYWORDS:

Protein turnover, muscle, essential amino acids (EAA), energy deficit, exercise, net protein balance, protein synthesis.

3. ACCOMPLISHMENTS:

- **What were the major goals of the project?**
 - The primary goal of Study 1 is to characterize the effects of graded Essential Amino Acid intakes on resting and post-resistance exercise skeletal muscle and whole-body protein kinetics after a 5-day-20% energy deficit.
- **What was accomplished under these goals?**
 - Study 1 was completed on March 20, 2019. Nineteen subjects have been studied.
 - All analyses associated with this study have been completed.
 - Data has been consolidated and kinetic calculations have been accomplished.
 - Problematic data points and/or samples are currently being re-analyzed.
- **What opportunities for training and professional development has the project provided?**
 - The project supports a post-doctoral fellow at UAMS, and provides training and professional development for a post-doctoral fellow at both UAMS and USARIEM.
 - This project serves as the primary conduit for the fellow's education and experience in the assessment of protein metabolism in response to various physiological interventions. The fellow learns the background rationale, methodology, study conduct, sample preparation and analyses, data analysis, data consolidation and interpretation, data presentation, and manuscript publication.
- **How were the results disseminated to communities of interest?**
 - Results from the first study have yet to be disseminated.
- **What do you plan to do during the next reporting period to accomplish the goals?**
 - Manuscript preparation for Study 1 is ongoing. We intend to have these results published prior to the next (annual) reporting period.
 - The next reporting period entails analyzing and consolidating the results from Study 2, scheduled to begin in August 2019.

4. IMPACT:

- **What was the impact on the development of the principal discipline(s) of the project?**
 - Thus far, the data indicate that a significant intake of EAA are required to offset the combined physiological impact of a caloric deficit and exercise.
 - We are utilizing these findings to discern an optimal delivery methodology/system for the required EAA in Study 2.
- **What was the impact on other disciplines?**
 - These findings may impact food delivery and/or format.

- The finding of an increased EAA requirement may impact the food matrix and/or delivery method and required revision of current food paradigm.

- **What was the impact on technology transfer?**

- Nothing to Report

- **What was the impact on society beyond science and technology?**

- Nothing to Report

5. **CHANGES/PROBLEMS:**

- **Changes in approach and reasons for change**

- One subject withdrew due to personal concerns with the dietary restrictions of the study.
- One subject withdrew prior to completing crossover design due to desire to move to duty station.
- One subject was withdrawn because they did not meet study criteria.

- **Actual or anticipated problems or delays and actions or plans to resolve them**

- Nothing to Report

- **Changes that had a significant impact on expenditures**

- Nothing to Report

- **Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents**

- Nothing to Report

- **Significant changes in use or care of human subjects**

- Nothing to Report

- **Significant changes in use or care of vertebrate animals.**

- No animal use research was performed to complete the Statement of Work.

- **Significant changes in use of biohazards and/or select agents**

- Nothing to Report

6. **PRODUCTS:**

- **Publications, conference papers, and presentations**

- **Journal publications.**

Manuscript preparation is underway.

- **Books or other non-periodical, one-time publications.**

Nothing to Report

- **Other publications, conference papers, and presentations.**

Nothing to Report

- **Website(s) or other Internet site(s)**

Nothing to Report

- **Technologies or techniques**

Nothing to Report

- **Inventions, patent applications, and/or licenses**

Nothing to Report

- **Other Products**

Nothing to Report

7. **PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS**

- **What individuals have worked on the project?**

Name:	Arny A. Ferrando, PhD
Project Role:	Principal Investigator
Researcher Identifier (e.g. ORCID ID):	https://orcid.org/0000-0003-2916-7878
Nearest person month worked:	4 months
Contribution to Project:	Involved in all aspects of study design, conduct, data collection, and data consolidation and interpretation. He will serve as the primary interface with USARIEM and Dr. Pasiakos. Further, will supervise the individual analytical aspects and laboratory personnel involved in this project.
Funding Support:	USAMRAA
Name:	Robert R. Wolfe, PhD
Project Role:	Co-Investigator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	1 month
Contribution to Project:	Involved in study design and data interpretation. His expertise in isotope methodology and metabolic studies provides unique and valuable insight for each study.
Funding Support:	USAMRAA
Name:	David Church, PhD
Project Role:	Postdoctoral Fellow
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	12 months
Contribution to Project:	Works directly with Dr. Ferrando on all aspects of this project. Assists USARIEM and Dr. Pasiakos' group with data collection and study conduct. Assists the Research Associate in sample preparation and analyses. Performs kinetic calculations and consolidates data for publication.
Funding Support:	USAMRAA
Name:	Sanghee Park, PhD
Project Role:	Jr. Investigator
Researcher Identifier (e.g. ORCID ID):	-
Nearest person month worked:	2 months
Contribution to Project:	Initially responsible for the calculation of muscle and whole-body protein kinetics, as well as the consolidation of kinetic data.

Funding Support:	USAMRAA
Name:	Rick Williams, MS
Project Role:	Research Associate
Researcher Identifier (e.g. ORCID ID):	-
Nearest person month worked:	6 months
Contribution to Project:	Responsible for processing muscle and blood samples for GCMS analyses. Also responsible for LCMS analyses, including the determination of tracer enrichment and amino acid concentrations.
Funding Support:	USAMRAA
Name:	Deborah Viane
Project Role:	Project Specialist
Researcher Identifier (e.g. ORCID ID):	-
Nearest person month worked:	3 months
Contribution to Project:	Responsible for monthly project expenditures and resolution of project-related costs. Responsible for acquisition of study-related materials, and the scheduling of travel arrangements for both the PI and Fellow. Also assists the PI in required project reporting.
Funding Support:	USAMRAA

- **Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**
 - Nothing to Report
- **What other organizations were involved as partners?**
 - US Army Research Institute of Environmental Medicine(USARIEM)
 - Organization Name: Headquarters, U.S. Army Medical Research and Materiel Command (HQ USAMRMC)
 - **Location of Organization:** Natick, MA
 - **Partner's contribution to the project:**
 - **Financial support:** N/A
 - **In-kind support:** N/A
 - **Facilities:** Human studies are conducted at USARIEM; USARIEM recruits volunteers
 - **Collaboration:** Staff, fellow, and PI collaborations
 - **Personnel exchanges:** Fellow travels to Natick/USARIEM to perform metabolic studies.
 - **Other:** N/A

8. **SPECIAL REPORTING REQUIREMENTS**

- **COLLABORATIVE AWARDS:**

None to Report
- **QUAD CHARTS:**

None to Report

9. **APPENDICES:**

None to Report

ADDITIONAL NOTES:

Unlimited Distribution A