

PPP Project Final Report 2018

The PPP-projects that have been established under the direction of the top sectors and will be completed before 1 March 2019 must submit a technical and financial final report. This format is to be used for the technical final report.

The report will be published on the websites of the TKIs/top sector, excluding the blocks 'Approval coordinator/consortium' and 'Changes to the original project plan' . Please ensure that no confidential matters are left in the remaining blocks.

The reports must be submitted before 15 February 2019 to Hans van der Kolk

General information	
PPP number	AF-16501
Title	Protein for endurance adaptation
Theme	Food & Health en Superior products & processes
Executive knowledge institution(s)	Radboud UMC (WP1), HAN (WP2) and WUR (WP3)
Research project leader (name + e-mail address)	Astrid Horstman, FrieslandCampina astrid.horstman@frieslandcampina.com
Coordinator (on behalf of private parties)	Harm Dijkstra (FrieslandCampina Nederland B.V.) Harm.dijkstra@frieslandcampina.com
Government contact person	n.v.t.
Total project size (k€)	K€931
Address project website	n.v.t.
Start date	6 October 2016
End date	31 maart 2019

Approval coordinator/consortium

The report should be discussed with the coordinator/the consortium. The TKIs appreciate being informed of possible feedback on the report.

The coordinator has assessed the report on behalf of the consortium	<input checked="" type="checkbox"/> approved <input type="checkbox"/> rejected
Feedback from the consortium coordinator on the report	n.v.t.

Short description/aim PPP

What is going on and how is this project involved?

What will be delivered by the project and what will be the effect of this?

WP1:

Ouder worden kan gepaard gaan met een afname van spiermassa. Hierdoor vermindert de spierkracht en daarmee verslechtert het dagelijks functioneren. Uit eerder onderzoek bij fragiele ouderen blijkt dat een verhoging van de eiwitname het verlies aan spiermassa en spierkracht kan verminderen, maar het is onbekend of dat ook zo goed werkt bij vitale, actieve ouderen. Het doel van dit onderzoek is het evalueren van de effecten van een eiwit-supplement op spiermassa, spierkracht en fysieke functionaliteit bij vitale, actieve ouderen. Daarnaast wordt gekeken wat het effect van het eiwit-supplement is op de fysieke prestatie en gezondheid van de botten en gewrichten tijdens de Nijmeegse Vierdaagse.

WP2: Over the past few years, there has been an increasing interest in the role of protein ingestion during and after endurance exercise to support physiological training adaptations. However, the proposed benefits of protein supplementation during prolonged endurance exercise training remains to be established. This WP aimed to assess the impact of protein supplementation on the increase in VO₂max and endurance exercise performance induced by prolonged endurance exercise training. For this purpose, sixty healthy young males were subjected to 12 weeks of

endurance exercise training, comprising three exercise sessions weekly. After each training session and each night before sleep, participants ingested either a protein supplement (28.7 g casein protein) or an isocaloric carbohydrate placebo. Hence, this WP will establish whether protein supplementation represents an effective means to augment improvements in VO₂max, time trial performance, muscular strength, muscular endurance, and body composition during prolonged endurance exercise training.

WP3:

The aim of this work package is to analyze energy metabolism in cells isolated from blood of participants in WP1 and WP2. We hypothesized that training and nutritional supplements could improve substrate switching for ATP production. In muscle this could improve adaptation and training capabilities. Using novel high-throughput techniques to analyze blood cell energy metabolism allows us to get a detailed overview of blood cell metabolic physiology and how this is influenced by training and nutritional supplements.

Changes to the original project plan and follow-up	
Have there been any changes in the consortium/project partners? If yes please explain	No
Have there been any changes in the project set up? If yes please explain.	No
Do you expect a patent application to arise from this PPP? If yes please explain	No
Do you expect spin offs to arise from this PPP? (including new projects) If yes please explain	No
in how many years will the private parties use results from this project in practice?	Probably in a few years, FC will launch products for endurance athletes or older people.
How has the project contributed to developments within the involved knowledge institution(s)? (e.g. scientific breakthroughs, new collaborations etc)	<p><u>WP1:</u> De bevindingen van het onderzoek bij fysiek actieve ouderen toont aan dat met de voorgestelde eiwitaanbeveling van 1.2 g/kg/d van de PROT-AGE study group voor deze doelgroep meer spiermassa behouden kan worden bij verouderen en zelfs resulteert in een lichte stijging van spiermassa. Het verhogen van de eiwitname had geen schadelijke gevolgen voor de nierfunctie. Overige effecten staan beschreven bij achieved results.</p> <p>Voor dit onderzoek is samengewerkt met diverse partijen voor de metingen: Huisartsdienst Nederland, Ziekenhuis Gelderse Vallei Ede, VUMC en LUMC.</p> <p><u>WP2:</u> The project served as an excellent learning environment for students of HAN University of Applied Sciences, as well as Wageningen University and Research and Maastricht University.</p> <p>The comprehensive project excellently showcases the research environment of HAN University of Applied Sciences.</p> <p><u>WP3:</u> A workflow was set-up between an industrial partner and the Wageningen University which strengthened public-private partnership relationships between WUR and FC. It also demonstrated the feasibility of such an approach to analyse blood cell energy profiles in large human (intervention) studies. The knowledge gained in this project helps Wageningen University setting up further research on studying</p>

	physiological changes in human dietary and exercise intervention studies.
What will be the follow up of this project?	Long-term studies; herstel na inspanning; specifieke ouderen producten: en dat allemaal bij vitale ouderen Energy profiles in blood cells will be analyzed in future studies at Wageningen University using similar methods.

Achieved Results

WP1:

Describe the deliverables of the project?

Het onderzoek is geanalyseerd en opgeschreven in 3 artikelen, waarvan 1 artikel reeds geaccepteerd is (zie deliverables).

What is the effect and for whom?

Het gebruik van het eiwitsupplement in 58 deelnemers met een lage habituele eiwitinname resulteerde in een grotere toename van spiermassa vergeleken met de placebogroep met 56 deelnemers. Deze verbetering in spiermassa bij de eiwitgroep resulteerde echter niet in een verbetering van spierkracht of fysiek functioneren, waarop de gehele groep op baseline al zeer hoog scoorden.

De deelnemers die eiwitsupplementen hebben gebruikt scoorden tijdens de Nijmeegse Vierdaagse hetzelfde (hoge) niveau bij de fysieke functionaliteitstesten als de placebo groep. Daarnaast was er geen verschil tussen de groepen voor de spierschade markers na het lange wandelen van lange afstanden. Eén inflammatoire marker (IL6) leek bij de eiwitgroep na 3 dagen wandelen sneller te dalen en dus sneller terug te keren naar normaalwaarden, maar dit zagen we niet terug in de andere inflammatoire markers. Tot slot zagen we dat er bij de eiwitgroep na de interventie periode minder kraakbeen afbraak (COMP) was dan bij de placebo groep.

Dankzij dit project weten we dat vitale, actieve ouderen met een lage habituele eiwitinname profijt kunnen hebben van een hogere eiwitinname, waarmee de afname van spiermassa uitgesteld of verminderd kan worden.

Which project parts differed from the original plan and what was the reason for this?

Het project binnen WP1 is niet afgeweken van het originele plan.

WP2:

Describe the deliverables of the project?

WP1: Het onderzoek is geanalyseerd en opgeschreven in 3 artikelen, waarvan 1 artikel reeds geaccepteerd is (zie deliverables).

WP 2: The randomized controlled trial conducted in WP2 has resulted in a scientific report on the impact of protein supplementation during prolonged endurance exercise training. The scientific report has been submitted for publication in an international peer-reviewed scientific journal.

The results of the study have been presented at the International Sport and Exercise Nutrition Conference (ISENC) in Newcastle (Dec, 2018). This presentation was awarded with a young investigator award for first author Dr. Kristin Jonvik. The results of the study will also be presented at the ACSM conference in Orlando, Florida (May, 2019) and ECSS conference in Prague (July, 2019).

What is the effect and for whom?

Although the study showed robust improvements in VO₂max, 10-km time-trial performance, muscular strength and muscular endurance following 12 weeks of endurance exercise training, these adaptations were not further augmented by supplementing ~30 g of protein after exercise and before sleep. The increase in leg lean mass following endurance exercise training tended to be greater in the protein supplemented individuals, although this finding did not reach statistical significance. The results in WP2 were observed in recreationally, active young males.

Which project parts differed from the original plan and what was the reason for this?
This project was completed according to the original plan.

WP3:

Describe the deliverables of the project?

Energy metabolism of blood cells obtained from participants in WP1 and WP2 was analyzed using extracellular flux analysis with optimized methods for PBMCs using the current state-of-the-art workflow. Blood cell energetic profiles were obtained in substrate-rich and substrate-poor conditions from WP1. Variation between participants in multiple energetic parameters was bigger than the effect that was induced by training or nutritional supplements. Therefore, to analyze the blood cell energetic profiles in WP2, more participants were included than in the WP1 study. Blood cell energetic parameters were analyzed and compared to physiological parameters that were obtained in WP2. Although overall no clear correlations were observed in many of the energetic parameters, especially in cohort 1 there were differences with training intervention in energetic status in blood cells. Mitochondrial oxygen consumption was altered after training, whereas glycolytic capacity was inversely correlated with mitochondrial oxygen consumption. These results demonstrate that blood cell metabolic analyses are suitable for future application in physical exercise training and nutritional supplementation studies. Furthermore, the results give mechanistic insights into how metabolic blood cell profiles change with training.

What is the effect and for whom?

The acquired knowledge can be used to predict how training and nutritional interventions will alter blood cell energetic profiles and can in the future be used to optimize training and nutrition that will benefit healthy living, optimal training and healthy aging.

Which project parts differed from the original plan and what was the reason for this?

There were no changes in the original plan.

Deliverables (description of the most important products and their target group)

WP1:

Diverse artikelen zijn geschreven en beschikbaar voor wetenschappers:

De resultaten van de 12 weken durende suppletie periode op spiermassa, kracht en functie is beschreven in het artikel getiteld: *Protein supplementation improves lean body mass in physically active elderly: a randomized double-blind placebo-controlled trial*. Dit artikel is reeds gepubliceerd.

De resultaten van de eiwit-suppletie op spierschade tijdens langdurige duurinspanning staan beschreven in het artikel getiteld: *The impact of protein supplementation on exercise-induced creatinine kinase elevations following prolonged walking exercise*. Dit artikel wordt in maart ingediend.

De resultaten van de 12 weken durende suppletie periode op bot en gewrichtsmarkering staat beschreven in het artikel getiteld: *The potential role of bone in body composition, cartilage health, and physical functioning, and possible changes in this role due to walk training and protein treatment*. Dit artikel wordt binnenkort ingediend.

Alle resultaten staan beschreven in het onderzoeksrapport van de vierdaagse 2017 en zijn bereikbaar voor het grote publiek: <http://vierdaagseonderzoek.nl/nl/home/8-nieuws/136-onderzoeksrapport-vierdaagse-2017>

De resultaten zijn gepresenteerd op twee nationale congressen: Foodvalley Summit Sports & Nutrition in Ede, Nederland en bij het symposium van de VvBN studentendag (Vereniging van Bewegingswetenschappen Nederland) In Amsterdam, Nederland.
en op het internationale congres ECSS (European College of Sport Science) in Essen, Duitsland.

WP2:

Scientific article: Protein supplementation does not further augment endurance capacity and performance following prolonged endurance exercise training: a randomized controlled trial (submitted for publication). Target population: scientists, (sport)nutritionists, physicians, trainer/coaches, industrial parties

Scientific presentation/abstract: Protein Supplementation Does Not Further Augment Physiological Adaptations to Prolonged Endurance Exercise Training. Target population: scientists, (sport)nutritionists, physicians, trainer/coaches, industrial parties

WP3:

Scientific article: profiling of energy metabolism in blood cells in healthy individuals and their correlations with training parameters will be published in peer-reviewed papers. Target population: scientists, clinicians, (sports)nutritionist, industrial parties.

Number of delivered products (in an appendix, please provide the titles and/or description of the products or a link to the products on public websites)			
Academic articles	Reports	Articles in journals	Introductions/workshops
WP1: 3	WP1: 1	WP1: zie academic articles below	WP1: 3
WP2: 1	WP2: -	WP2: submitted for publication	WP2: 3 presentations at international conferences (ISENC, ACSM, ECSS)
WP3: -	WP3:-	WP3: in preparation for publication	

Appendix: Names of the products or a link to the products on a public websiteWP1:**Academic articles / articles in journals:**

ten Haaf D.S.M., Eijsvogels T.M.H., Bongers C.W.G., Timmers S., de Groot L.C.P.G.M., Hopman M.T.E. *Protein supplementation improves lean body mass in physically active elderly: a randomized double-blind placebo-controlled trial.* Journal of Cachexia, Sarcopenia and Muscle, 2019. [Epub ahead of print]

ten Haaf D.S.M., Bongers C.W.G., Eijsvogels T.M.H., Hopman M.T.E. *The impact of protein supplementation on exercise-induced creatinine kinase elevations following prolonged walking exercise.* In preparation.

The potential role of bone in body composition, cartilage health, and physical functioning, and possible changes in this role due to walk training and protein treatment

Reports:

<http://vierdaagseonderzoek.nl/nl/home/8-nieuws/136-onderzoeksrapport-vierdaagse-2017>

Introduction/workshops:

Presentatie Foodvalley Summit Sports & Nutrition – Ede, NL
Protein intake in physically active elderly: prevention over treatment

Presentatie ECSS (European College of Sport Science) - Essen, Duitsland.

The effect of protein intake on muscle mass, muscle strength and muscle function in physically active elderly

Presentatie bij het symposium van de VvBN studentendag (Vereniging van Bewegingswetenschappen Nederland) – Amsterdam, Nederland

The effect of amount and distribution of protein intake on muscle strength and muscle function in physically active elderly.