



General information	
PPP number	TKI-AF-16011
Title	Plant Meat Matters. Towards a next generation meat analogues.
Roadmap/Umbrella	Topsector Agri & Food, Roadmap High quality products and processes
Executive knowledge institution(s)	Wageningen University & Research
Research project leader (name + e-mail address)	Ariette Matser Ariette.matser@wur.nl
Coordinator (on behalf of private parties)	Peter Hoste, Meyn
Government contact person	
Start date	1 January 2017
End date	31 December 2021

Approval coordinator/consortium	
The coordinator has assessed the annual report on behalf of the consortium:	<input checked="" type="checkbox"/> approved <input type="checkbox"/> rejected
Possible feedback on the annual report:	

Short content description/aim PPS
Plant Meat Matters will build the required scientific basis to understand the structuring process of meat analogues while including flavour components, fat and other ingredients. Together with partners that span the entire vegetable protein chain, this basis will be used to further develop technologies for making the next generation of consumer-accepted meat analogues with improved characteristics that can be produced more cost-effectively and will have reduced environmental impact compared to meat analogues currently available on the market.

Planning and progress	
Is the PPP going according to plan? ¹	Yes
Have there been changes in the consortium/project partners?	No
Is there a delay and/or deferred delivery date?	No
Are there any substantive bottlenecks? Provide a brief description	No
Are there any deviations from the projected budget?	No

¹ If applicable, use the explanation from the financial project report

	<p>Part of the research in Plant Meat Matters will be performed by PhD students. These students started during the first project year. Starting dates were 1 February 2017 (WP5), 1 June 2017 (WP7), 1 December 2017 (WP4) and 1 December 2017 (WP3). Especially for the last two positions, it was difficult to find good candidates. Part of the planned budget for 2017 will therefore be used in later years.</p> <p>To make it possible for all PhD candidates to perform their research within the project duration and to make sure that the essential combination between fundamental and applied research can be reached within Plant Meat Matters, the project duration was therefore extended to 2021.</p>
Do you expect a patent application to arise from this PPP?	Yes

<p>Current summary of the project for the website Kennisonline</p> <p>The high and increasing consumption of products from animal origin is one of the key factors making current food production routes insufficiently efficient to feed the growing, and more affluent world population. Meat production is inefficient with respect to the use of land, water and raw materials. In addition, there is an increasing resistance against the meat industry in the Western World on for example animal welfare grounds.</p> <p>Nutritionally, peas or soy would be excellent protein sources, but most consumers prefer meat. The fact that meat is a product that is fibrous on various length scales including the nanometer scale, is for a major part responsible for this: the flavour components are gradually released upon chewing, giving a good taste experience during the complete duration of mastication.</p> <p>A route to reduce the consumption of those products is the development of plant-based analogues for meat or meat-like products. Consumer sciences indicated that products that resemble the original will have the highest chance of success to be picked up by the broadest range of consumer groups. In recent years, Wageningen University and the Technical University of Delft jointly developed a novel technology for the production of fibrous, plant-based materials on nano to meso scale, resembling the structure and bite of meat better than commercial products that are currently available to consumers. This fibrous material could therefore form the basis of the next generation of meat analogues.</p> <p>Plant Meat Matters has the following vision and ambition towards a next generation of meat analogues:</p> <ul style="list-style-type: none"> • Reduced consumption of products from animal origin is a key step towards a sustainable diet, and can be achieved by direct replacement by textured plant-based products • Ingredients necessary for meat analogues can be produced with higher efficiency, and reduced use of energy, water and chemicals when focusing on the right ingredients for meat analogues rather than on pure ingredients • Producing less waste by production of meat analogues is possible by keeping food fresh for longer and on demand production of meat analogues <p>Project objectives:</p> <ul style="list-style-type: none"> • Improve scientific basis for next generation meat analogues <ul style="list-style-type: none"> ○ Product quality: water binding, fat, flavours, etc. ○ Ingredient flexibility & possibilities for processing • Further development of technologies and ingredients for meat analogues <ul style="list-style-type: none"> ○ Consumer accepted and improved characteristics ○ Cost-effective process with reduced environmental impact • Enable partners to develop and produce better meat analogues, ingredients, flavouring and equipment.

Link naar openbare websites:

<https://www.wur.nl/en/Research-Results/kennisonline/AF16011-Plant-Meat-Matters.htm>
<https://www.youtube.com/watch?v=HP8Y7faobqI>

Highlights:

In January 2017, Plant Meat Matters started with eight industrial partners, Wageningen Food & Biobased Research and Wageningen University. The project is divided into 8 work packages. WP 1 and 2 focus on bridging the technology gap and build on background knowledge and results from the 6 other work packages. WP 3-6 focus on understanding the structuring process by in depth research involving PhD students. Knowledge transfer is addressed in WP 8 focussing on communication and dissemination.

The highlights for 2017 are described below for the different work packages.

WP 1 Upscaling and maturing shear cell technology

The aim of WP1 is to develop shear cell technology for high-quality meat analogues and to deliver full scale solutions for meat analogue production. In 2017, we have focussed on creating a more detailed project planning, and performed research activities on the influence of the different functional steps of the structuring process. This includes pre- and post-processing, e.g. standardizing process conditions for mixing and storage of the dough and processing in the shear cell, e.g. influence of heating, cooling and shear rate on texture. The results will serve as input for upscaling and maturing shear cell technology.

WP 2 Developing meat analogue products with excellent taste and texture and investigating consumer acceptance of those products

The goal of WP2 is to develop meat analogue proof of principle prototypes with excellent taste and texture for launching further development by the partners. The development of these prototypes is based on understanding of consumer wishes, available equipment and understanding of the effects of different ingredients. In 2017, we created a detailed project planning, developed methods and standards for preparation and evaluation of shear cell samples and performed research on the relation between visco-elastic profiles, dough textures and product texture for various ingredients.

WP 3 Understanding the structuring potential of oilseeds, which includes the effect of fractionation

The aim of this WP is the understanding of structuring of oil seeds, including the effect of oil extraction and fractionation. In this WP, three PhD students are active. Activities in 2017 focussed on the understanding of structuring of soy protein, and showed that the creation of fibrous structures is a careful balance between the blend properties and process conditions. The highlights in this WP are focussing on three topics:

- Understanding fiber formation in a concentrated soy protein-isolate-pectin blend
- Viscoelastic properties of SPI-pectin blends: richer than a simple composite material
- Aqueous fractionation processes of soy protein for fibrous structure formation.

The results are described in three scientific publications.

WP 4 Investigating the structuring potential of protein concentrates and isolates from pulses and beans, including the effect of mild fractionation

This WP focusses on the relation between fractionation and properties in shear cell technology for pulses and beans. Activities are related to:

- Functional fractionation with reduced energy costs
- Quantifying function and structuring behaviour
- Understanding the potential of starch and other carbohydrates in meat analogue applications.

The PhD student active in this WP started 1 December 2017.

WP 5 Understanding mechanical properties, juiciness and flavour release of structured protein systems

The aim of WP5 is to improve the juiciness of meat analogues produced with the shear cell by generating a better understanding of the underlying mechanisms that control juiciness. In February, the PhD student active in this WP started. In 2017, the focus was on the development of a first model for water holding in meat analogues. Experiments were performed showing that different water binding is present in meat analogues and is influenced by ingredient composition and structures present in the final product.

WP 6 Towards the development of plant-based alternatives for meat-derived ingredients in pet food

The aim of this WP is to research the possibilities for vegan pet food, using shear cell technology. Making vegan pet food gives rise to challenges that are similar to making products for human consumption, but has some additional requirements to texture, taste and nutrients. In January 2017, the PhD student started in this WP. Activities in 2017 focussed on method development and first experiments with shear cell products towards formulation for animals.

WP 7 A sustainability analysis of various alternatives for meat

The aim of this WP is to make a sound sustainability analysis on the production of meat analogues. To create a structured protein product from plants, processing is necessary to obtain ingredients with right nutritional profile and to assemble it into final products. This requires many processing steps, of which a number are energy intensive and can lead to biomass losses. In June 2017, a PhD student started in this WP. Activities focussed on analysing results of Life Cycle Assessment (LCA) of meat analogue production, coupling nutrition to sustainability and the role of structure in exergy analyses. This will be described in a scientific publication.

WP 8 Communication and dissemination

This WP focusses on the internal and external communication and dissemination of Plant Meat Matters. In 2017, two general meetings and multiple WP meetings were organised where all partners were present. A logo and brochure were developed for external communication. Although the project started in 2017, Plant Meat Matters already resulted in various dissemination activities. In the appendix you will find the overview of scientific publications, contributions to conferences and other dissemination activities (e.g. publications in professional journals, newspapers). Some examples of dissemination activities are:

- First scientific publications
- Item at NOS Radio 1 Journal and NOS.nl
- 4 pages article in the Dutch newspaper De Volkskrant

Number of delivered products in 2017			
Academic articles	Reports	Articles in journals	Introductions/workshops
3*	0	6	2

*Three articles submitted, of which one accepted in 2017 and 2 in 2018

Appendix: Names of the products or a link to the products on a public website

Scientific publications

	What	Title	Date
1	Scientific publication	Viscoelastic properties of SPI-pectin blends: richer than a simple composite material. Birgit L. Dekkers, Remko M. Boom, Atze Jan van der Goot. Submitted for publication.	December 2017
2	Scientific publication	Aqueous fractionation processes of soy protein for fibrous structure formation. Marlies Geerts, Birgit Dekkers, Albert van der Padt, Atze Jan van der Goot. Innovative Food Science & Emerging Technologies, 45, 2018, 313-319	2018
3	Scientific publication	Understanding fiber formation in a concentrated soy protein isolate - pectin blend. Birgit L. Dekkers, Remco Hamoen, Remko M. Boom, Atze Jan van der Goot. Journal of Food Engineering, 222, 2018, 84-92	2018

Contributions to scientific conferences

	What	Title	Date
1	Presentation	Presentation Plant Meat Matters. Atze Jan van der Goot. 10th Protein Summit 2017. Creating New Protein Strategies. 26-28 September 2017, Reims, France	September 2017
2	Poster and presentation	Understanding fiber formation in a concentrated soy protein-pectin blend. Birgit Dekkers, Remko Boom, Atze Jan van der Goot. Conference Delivery of functionality in complex food systems', 5 to 8 November 2017 in Auckland, New Zealand	November 2017

Other dissemination activities

	What	Title	Date
1	Publications based on press release	Publications in newspapers based on press release of PMM: http://nos.nl/artikel/2161713-unilever-stapt-in-plantaardige-biefstuk-dit-is-een-doorbraak.html http://www.telegraaf.nl/binnenland/27746781/_Plantaardige_biefstuk_Unilever_.html http://www.volkskrant.nl/economie/unilever-en-andere-multinationals-stappen-samen-in-plantaardige-biefstuk~a4471105/ http://www.ad.nl/economie/universiteit-wageningen-en-unilever-werken-aan-doorbraak-vegetarische-biefstuk~a4f6ae9f/ https://www.trouw.nl/religie-en-filosofie/unilever-gaat-voor-vegabiefstuk-nu-de-aandeelhouders-nog~a8aadb0e/ http://www.nu.nl/eten-en-drinken/4150164/onderzoekers-maken-biefstuk-van-plantaardige-ingredienten.html http://www.marketingtribune.nl/food-en-retail/nieuws/2017/03/unilever-stapt-in-vleesvervangers/index.xml http://www.maxvandaag.nl/sessies/themas/eten-drinken/plantaardige-biefstuk-stapje-dichterbij/ http://nieuws.nl/eten/20170308/eerste-vegetarische-biefstuk-straks-geserveerd-worden/ http://www.boerderij.nl/Home/Nieuws/2017/3/Onderzoek-naar-industriële-plantaardige-biefstuk-103190E/ http://www.voedingnu.nl/Nieuws/WUR_planteneiwitten_m_et_de_textuur_van_biefstuk-170308080000 http://hoogenlaag.nl/lokaal/wur-werkt-aan-plantaardige-biefstuk-218862	March 2017

		http://radar.avrotros.nl/nieuws/detail/universiteit-werkt-aan-plantaardige-biefstuk-met-steun-van-multinationals/ http://gfcnieuws.org/wageningen-universiteit-werkt-aan-plantaardige-biefstuk/ https://mmv.nl/nieuws/gezonde-biefstuk-binnen-handbereik http://www.melkvee.nl/economie/nieuws/10386/wagening-en-ur-zet-stap-in-ontwikkeling-vegetarische-biefstuk https://www.nieuweoogst.nu/nieuws/2017/03/07/unilever-stapt-met-wageningen-ur-in-vleesvervangers http://www.food-nutrition.nl/nieuws/onderzoek-maakt-industriële-productie-plantaardige-biefstuk-mogelijk/ http://theoptimist.nl/wageningen-werkt-aan-plantaardig-biefstuk/ https://www.foodholland.nl/nieuws/artikel.html?id=189686 http://www.cirrus.nl/rssfeed/5515522/unilever-stapt-in-plantaardige-biefstuk-dit-is-een-doorbraak http://www.duurzaambedrijfsleven.nl/voeding/21511/unilever-werkt-mee-aan-ontwikkeling-vegetarische-biefstuk http://www.omroepgelderland.nl/nieuws/2129487/Doorbraak-universiteit-werkt-met-Unilever-aan-vleesvervanger http://www.waarmaarraar.nl/pages/re/101255/De_eerste_vegetarische_biefstuk_kan_straks_geserveerd_worden.html http://www.dutchnews.nl/news/archives/2017/03/unilever-joins-wageningen-vegetable-steak-project/	
2	Publication in professional journal	Vlees is passé. Vijf alternatieven voor de kotelet. Zo komt de mens straks aan zijn eiwitten. Karbonadje 2.0. Marc Seijlhouwer. De Ingenieur. April 2017, p11-19	April 2017
3	Publication in newspaper	Lab vlees. Waarom het ineens wel heel hard gaat met het niet-van-echt-te-onderscheiden vegetarische vlees. Mac van Dinther. Volkskrant 12 July 2017. pV5-V9	July 2017
4	Interview	Interview Food Navigator Niamh Michail 2017, http://www.foodnavigator.com/Market-Trends/Plant-Meat-Matters-Unilever-Givaudan-and-Ingredion-invest-in-vegetarian-steak?utm_source=newsletter_daily&utm_medium=email&utm_campaign=13-Mar-2017&c=xEcK4N6UA4cDExIAIPj2z2K2OXW%2FcCPQ&p2=	2017
5	Interview	Interview Samantha Boh, 2017, The Straight Times, Singapore, http://www.straitstimes.com/singapore/mock-meat-made-to-feel-like-the-real-deal	2017
6	Interview	Interview Albert Sikkema, Resource Wageningen 2017 https://resource.wur.nl/nl/show/Vleesvervangers-uit-de-snelkookpan.htm	2017

Akkoord: Hans van der Kolk (Topsectorsecretaris)