



<b>General information</b>	
PPP-number	TKI-AF 18030
Title	PROSPEC - Processing of pectin and chitin/chitosan from side streams into functional and high-value ingredients for home & personal care as well as food products
Theme	Circular / Circulair
Implementing institute	Wageningen Food & Biobased Research
Project leader research (name + e-mail address)	Frits de Wolf (frits.dewolf@wur.nl)
Coordinator (on behalf of private partners)	Wageningen Food & Biobased Research
Project-website address	n.a.
Start date	01 April 2019
Final date	01 April 2023

<b>Approval by the coordinator of the consortium</b>	
The annual report must be discussed with the coordinator of the consortium. The "TKI's" appreciate additional comments concerning the annual report.	
Assessment of the report by the coordinator on behalf of the consortium:	<input type="checkbox"/> Approved <input type="checkbox"/> Not approved <input checked="" type="checkbox"/>
Additional comments concerning the annual report:	n.a.

<b>Summary of the project</b>	
Problem definition	<p>Pectin is abundant in waste streams of for example the potato-, or fruit-processing industries, and chitin in side streams of crustacean seafood-processing and fermentation industries. Isolation and valorisation of these polysaccharides is an important step towards waste reduction and economic growth in these industrial sectors, implying – in addition - a more efficient use of arable land and marine resources. Using mild biocatalysis, these polysaccharides will be converted into valuable natural derivatives with enhanced/novel functionality, for replacement of petrochemical molecules and polymers in industrial applications such as household and personal (HPC) formulations, and for food applications. The use of enzymes enables the selective production of special derivatives that cannot be made by chemical means, while uncommon, not (yet) commercially available enzymes exist that enable the formation of special, novel derivatives. The 'green' origin, biodegradability and enhanced or novel functionality of the pectin- and chitin-based ingredients will reduce the ecological footprint of HPC products and increase consumer acceptance, thus conferring economic security. While a significant amount of work has been conducted around the world into the extraction of polysaccharides from biomass, less information and capability are available for the structural analysis of raw materials and the biotransformations of these into more well understood functional polymers. Based on initial data and literature, we hypothesize that small changes in structure, architecture and molecular weight of these polysaccharides can have significant effects on their performance.</p>
Project goals	To steer ingredient design and selection, a database of structure-function relationships will be built. For this purpose we will develop a scalable biocatalytic approach for the creation of a series of pectin and chitin/chitosan derivatives. These will be analysed, and optionally

	<p>further processed for eventual application in HPC formulations by a large industrial partner involved in the project. In addition to this partner, the project comprises one SME as well as two non-SME industries with pectin-rich side streams, an established enzyme-developing and –producing SME, a pectin-processing industry and a chitin-processing SME. The project consortium and activities cover the entire chain from biomass to industrial application. The choice, laboratory scale production and optimisation of uncommon, not commercially available enzymes is facilitated (with a view to eventual scale-up production) by the enzyme-producing industry in the consortium. We will develop and/or advance methods for the efficient (optionally enzyme-facilitated) extraction of pectins from side streams provided by the industrial partners in the consortium, while initial test material for the development of enzymatic processes will be provided by pectin- and chitin/chitosan-producing industrial consortium members. We will develop enzymatic processes for the targeted modification of pectin and chitin/chitosan and we will develop novel cost-effective ways to produce not commonly available enzymes. In addition to enzymatic processes for HPC ingredients, we will develop enzymatic processing of specifically pectin into nutri-active components for health and medicinal foods.</p>
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<b>Results</b>	
Planned results 2019	<ul style="list-style-type: none"> <li>- Extraction of potato- and citrus peel-derived pectins in relation to pre-extraction (storage) conditions, for generation of pectin as a substrate for enzymatic modification.</li> <li>- Making an inventory of (i) desired properties of modified pectin and chitosan for HPC applications, and of (ii) suggested modifications to obtain such properties.</li> <li>- Making an inventory of potentially suitable enzymes to obtain these modifications and pectin- chitosan- properties.</li> <li>- Selecting enzymes and primary enzyme structures (amino acid sequences) of commercially not available enzymes to be used in the project, for expression in a heterologous microbial host.</li> </ul>
Achieved results 2019	<ul style="list-style-type: none"> <li>- Citrus peels and pectin-containing potato side streams were delivered by industrial consortium members and some pectin extracts were made from those materials</li> <li>- A first inventory was made of (i) desired properties of modified pectin and chitosan for HPC applications, and of (ii) suggested modifications to obtain such properties.</li> <li>- Potentially suitable enzymes to obtain these modifications and pectin- chitosan- properties were pinpointed, as well as corresponding approaches for modification of extracted pectins and chitosan.</li> <li>- Enzymes and primary enzyme structures (amino acid sequences) of commercially not available enzymes to be used for pectin modification in the project were analysed and selected</li> <li>- Corresponding enzyme-encoding DNA sequences were designed and are currently being constructed, for expression in a heterologous microbial host.</li> </ul>
Planned results 2020	<ul style="list-style-type: none"> <li>- First series of enzyme-mediated pectin modifications</li> <li>- Optimization of pectin extraction method</li> <li>- Expression in a heterologous microbial host of one or more desired enzymes for pectin modification, which are currently not commercially available</li> <li>- Purification of the enzymes as needed</li> <li>- Application of the recombinant enzyme(s) in pectin modification</li> <li>- Expression strain optimization</li> <li>- Analysis of the functional properties of the first set of modified pectins and start of the construction of a database of structure-function relationships</li> </ul>

	<ul style="list-style-type: none"> <li>- Selection of amino acid sequences of commercially not available chitin/chitosan modifying enzymes to be used for chitin/chitosan modification in the project, design of DNA sequences encoding the enzymes and their expression in a heterologous microbial host organism.</li> <li>- First series of enzymatic chitin/chitosan modifications using commercially available enzymes.</li> </ul>
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<p><b>Deliverables/products in 2019</b> (provide the titles and /or a brief description of the products/deliverables or a link to a website.)</p>
<p><u>Scientific articles:</u></p> <p>Not yet</p>
<p><u>External reports:</u></p> <p>Not yet</p>
<p><u>Articles in professional journals/magazines:</u></p> <p>Not yet</p>
<p><u>(Poster) presentations at workshops, seminars, or symposia.</u></p> <p>Not yet</p>
<p><u>TV/ radio / social media / newspaper:</u></p> <p>N.a. thus far</p>
<p><u>Remaining deliverables (techniques, devices, methods, etc.):</u></p> <ul style="list-style-type: none"> <li>• Extracted material</li> <li>• Selected enzymes pinpointed</li> <li>• First enzyme-encoding genes designed and being constructed</li> <li>• Priority listing of desired pectin modifications</li> </ul>

<https://topsectoragrifood.nl/project/af-18030-prospec-processing-of-pectin-and-chitin-chitisan-from-side-streams-into-functional-and-high-value-ingredients/>

<https://www.wur.nl/nl/Onderzoek-Resultaten/Onderzoeksprojecten-LNV/Expertisegebieden/kennisonline/Processing-of-pectin-and-chitin-chitosan-from-side-streams-into-functional-and-high-value-ingredients.htm>