



PPS-eindrapportage

Algemene gegevens	
PPS-nummer	TKI-AF-14506 (RE003)
Titel	Red discoloration of fresh-cut leafy vegetables
Roadmap/Koepel	TKI A&F
Uitvoerende kennisinstelling(en)	Wageningen Food & Biobased Research – Fresh Food in Chains (FFC BU unit) - Postharvest Technology group TNO – Microbiology and System biology
Projectleider onderzoek (naam en emailadres)	Maxence Paillart (maxence.paillart@wur.nl)
Penvoerder PPS (namens private partij)	W. Heemskerk b.v.
Contactpersoon overheid	
Werkelijke startdatum	1 September 2014
Werkelijke einddatum	30 September 2016
Korte omschrijving inhoud (bij voorkeur 4 regels, max. half A4)	<p>Pink discoloration of fresh-cut iceberg lettuce is one of the main quality decay observed on lettuce product when packed within atmosphere too rich in oxygen. In other hand packing lettuce under strict anaerobe gas condition engenders other quality issues (off-odour and off-taste). In this project we aimed to desensitise fresh-cut lettuce to oxidation processes in order to pack the treated lettuce under atmosphere slightly enriched with oxygen in order to restrain quality losses issued of anaerobe condition.</p> <p>A basis model was created in order to study the effect of mild heat-shock treatments and chemical treatments on the pink discoloration of iceberg lettuce. The specific enzyme activity (PAL activity), responsible for pink pigment formation, was also investigated. The basis model showed that mild heat-shock treatment need to be optimised to reduce significantly the enzyme activity responsible for pinking discoloration without damaging the lettuce tissue. Concerning the chemical treatments, only ascorbic acid and citric acid showed promising results. However it was essential to apply these chemicals after cutting process and to not wash out these chemicals from the treated lettuce leave.</p> <p>Chemicals are efficient against pink discoloration during the shelf life period only when they stays in contact with the plant tissue.</p> <p>An optimal heat-shock treatment has been determined and applied on fresh-cut iceberg lettuce packed under modified atmosphere conditions.</p> <p>The microbial population dynamic of heat shock treated lettuce was compared to the non-treated samples. Heat-shock treatment did not affect the microbial population dynamics during the shelf life period.</p> <p>Extension of the shelf life was unfortunately not observed for treated lettuce when packed in standard</p>

	commercial packaging. When using packaging slightly more permeable, treated lettuce should however show a longer shelf life.
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Goedkeuring penvoerder / consortium	
De eindrapportage dient te worden besproken met de penvoerder/het consortium. De TKI's nemen graag kennis van evt. opmerkingen over de rapportage.	
De penvoerder heeft namens het consortium de eindrapportage	<input type="checkbox"/> goedgekeurd <input type="checkbox"/> niet goedgekeurd
Evt. opmerkingen over de eindrapportage:	

Mutaties ten opzicht van het oorspronkelijke projectplan en follow-up	
Zijn er wijzigingen geweest in het consortium / de projectpartners? Zo ja, benoem deze.	nee
Zijn er inhoudelijke wijzigingen geweest in het project?	Specific quantitative PCR (qPCR) for <i>Enterobacteria</i> , <i>Leuconostoc</i> , <i>Pseudomonas</i> and total bacteria (both live and dead) by using propidium monoazide approach at time-points was not performed in this project. We figured out that the replicability of this method was insufficient for our research purpose.
Is er sprake van knelpunten bij de uitvoering van het project?	
Is er sprake van afwijkingen van het ingezette budget/de begroting?	
Is er sprake van een octrooi-aanvraag (evt. first filing) vanuit deze PPS?	nee
Is er sprake van spin-offs (contract-onderzoek dat voortkomt uit dit project, aanvullende subsidies die zijn verkregen of spin-off bedrijvigheid)	nee

Resultaten en deliverables	
1. Welke deliverables zijn opgeleverd? (geef een korte beschrijving per deliverable uit het projectplan)	Poster presentation "Effect of heat shock treatments against discoloration of iceberg lettuce" at Fruit & Veg Processing conference (4-6 April 2016, Avignon (France)) Paper: Paillart MJM, Otma EC and Woltering EJ. "Effect of mild heat-shock treatments on pink discoloration and physiological parameters in fresh-cut iceberg lettuce" LWT – Food Science and Technology Interview in VMT Magazine (vakblad) (April 2017)
2. Indien bepaalde deliverables niet gehaald zijn, wat was daarvoor de reden?	
3. Heeft het project onverwachte (neven)uitkomsten opgeleverd, die vooraf niet waren voorzien? Zo ja, benoem deze.	Shelf-life extension of the treated samples was not obtained during the last experiment (proof of principle). This unexpected result was mainly due to: <ul style="list-style-type: none"> - Packaging used to pack the treated lettuce were still too impermeable - The initial microbial population of the untreated and treated lettuce differed significantly from the one's normally observed on produces coming

	from the commercial plant. No lactic acid bacteria were detected. The dynamic of the microbial population did not follow the same pattern that one's observed and described in previous work.
4a. Binnen hoeveel jaar zullen de private partijen resultaten uit dit project gaan gebruiken in de praktijk?	With additional research, company should be able to applied this process within 2 years.
4b. Kan het gebruik van de resultaten in de praktijk nog worden versneld, en zo ja, wat is daarvoor nodig?	Yes, <ul style="list-style-type: none"> - Repeat the proof of principle while ensuring that microbial population is similar to one observed in processing company (treat lettuce directly at processing plant) - Work in close collaboration with packaging company in order to use packaging with "dynamic" permeability properties (oxygen permeability adjust in function of the relative humidity)
4c. Op welke wijze is over het project en de resultaten gecommuniceerd naar de brede doelgroep (incl. niet-deelnemende bedrijven)?	<ul style="list-style-type: none"> - One scientific publication - Attend a 3 days international conference in Avignon in France - One article in professional journal (VMT, publication in April 2017)
5. In hoeverre heeft het project bijgedragen aan de ontwikkeling van de betrokken kennisinstelling(en)? (bijv. wetenschappelijk track record, nieuwe technologie, nieuwe samenwerkingen)	<p>Within this project, we have been able to identify the physiological mechanisms responsible for the pink discoloration of fresh-cut iceberg lettuce. We figured out that several processing treatments can reduce significantly these quality decay symptoms but the optimal application range is really narrow.</p> <p>We presented these results at an international conference about processing's fruit and vegetables and we wrote a scientific paper.</p>
6. Krijgt het project een vervolg in de vorm van een nieuw project of een nieuwe samenwerking? Zo ja, geef een toelichting.	Nee

Highlights: geef een korte beschrijving van de belangrijkste resultaten
<p>Pink discoloration of fresh-cut iceberg lettuce can be reduced by applying a mild heat treatment during processing. The heat-shock temperature and application time need to be optimized in order to be inactivate the enzyme activity of the produce without damaging the lettuce tissue.</p> <p>Application of chemicals can, to a lesser extent, reduce the pink discoloration symptoms. However chemicals need to remain on the produce tissue during the complete storage period to assure its efficiency against discoloration.</p> <p>Heat-shock treatment did not modify the microbial population dynamic of the treated lettuce compared to the microbial population dynamic observed on non-treated product.</p>

Aantal opgeleverde producten in 2016 (geef in een bijlage de titels en/of omschrijving van de producten of een link naar de producten op openbare websites)			
Wetenschappelijke artikelen	Rapporten	Artikelen in vakbladen	Inleidingen/ workshops
1		1	1

Kosten: Geef in deze tabel aan welke kosten gemaakt zijn. Splits dit uit naar de verschillende projectpartners. Bij private partijen gaat het hierbij om de in kind inbreng in de PPS		
Naam partner	Begroot (k€) (uit projectplan)	Gerealiseerd (k€)
Kennisinstellingen/publieke partijen		
WFBR	k€ 100	
TNO	k€ 25	
Totaal kennisinstellingen	k€ 125	
Bedrijven/private partijen		
W. Heemskerk	k€ 125	
Totaal bedrijven/privaat	k€ 125	
Totaal kosten (publ. + priv.)	k€ 250	

Financiering: Geef in deze tabel de financiering aan. De totale financiering moet even hoog zijn als de totale kosten per partner						
Naam	Kvk nr. (bij private partij)	Gerealiseerde private cash bijdrage 1)	Gerealiseerde private in kind bijdrage	Overig publiek (DLO, NWO, regio, etc.)	TKI toeslag	Totale financiering
Publieke kennisinstellingen						
Wageningen Food & Biobased Research			Nvt	21000	79000	100000
TNO			Nvt	9000	16000	25000
			Nvt			
			nvt			
Private partners						
W. Heemskerk BV	28020075		125000			125000
Totaal PPS						
Percentage private financiering	50%					

1) Specificatie van de private cash bijdrage

1) Specificatie van de private cash bijdrage: Geef in onderstaande tabel weer welke bedrijven de private cash hebben geleverd. Let erop dat het totaalbedrag overeenkomt met de totale cash bijdrage van de vorige tabel		
Private partner	Kamer van koophandel nr.	Bedrag in €
Totaal		

Bijlage: Titels van de producten of een link naar de producten op een openbare website

Scientific publication:

Paillart M.J.M., Otma E.C. and Woltering E.J. "Effect of mild heat-shock treatments on pick discoloration and physiological parameters in fresh-cut iceberg lettuce" LWT – Food Science and Technology 2017 (in press)

<http://dx.doi.org/10.1016/j.lwt.2016.11.054>

Conference / Workshops:

Poster presentation during the Fruit & veg processing conference (4-6 April 2016) in Avignon (France) "Effect of heat shock treatments against discoloration of iceberg lettuce"

Publication in professional journal:

"Een THT-winst van twee dagen is mogelijk"

Onderzoek naar de kwaliteit en houdbaarheid van verse gesneden ijsbergsla

VMT Magazine April 2017

Internal report:

"Applying heat shock treatments to extend shelf life of commercial packed fresh-cut iceberg lettuce" Batziakas Konstantinos (December 2014)

"Determination of the optimal packing to extend the shelf life of fresh-cut iceberg lettuce treated with heat shock treatment" Marie Nagy (August 2015)

Presentations:

"Red discoloration of fresh-cut leafy vegetables: Literature overview" Maxence Paillart and Ernst Woltering (14th January 2015)

"Red discoloration of fresh-cut leafy vegetables: New technologies and impact on shelf life" Maxence Paillart and Ernst Woltering (4th December 2015)

"Applying chemical treatment to extend shelf life of commercially packed fresh-cut iceberg lettuce" Maxence Paillart, Xin Du and Ernst Woltering (14th February 2017)

"Red discoloration of fresh-cut leafy vegetables. Heat-shock: Effect on pink discoloration and on bacterial microbiota" Maxence Paillart and Jos van der Vossen (15th March 2017)