# D3.5 Effect of hostharvest conditions on the quality of berries

15th October 2014

FOOD & BIOBASED RESEARCH
WAGENINGEN UR

EUBerry

# What have been performed in EU Berry

- Package of raspberry (P9 – Fatima Pereira Da Silva)
  - Effect of Ozon
- Gamma irradiation (P4 - Claudia Nunes dos Santos)

- Hypobaric treatments (P2 - Krzysztof Rutkowski)

# Objective

**To study alternative packaging concepts to extend the shelf life of raspberries**

- Fatima Pereira Da Silva

*Shelf life is now 5 – 6 days*

# Approach

1) Establish product requirements

2) Design alternative packaging concepts

3) Test shelf life of raspberries packed on these concepts

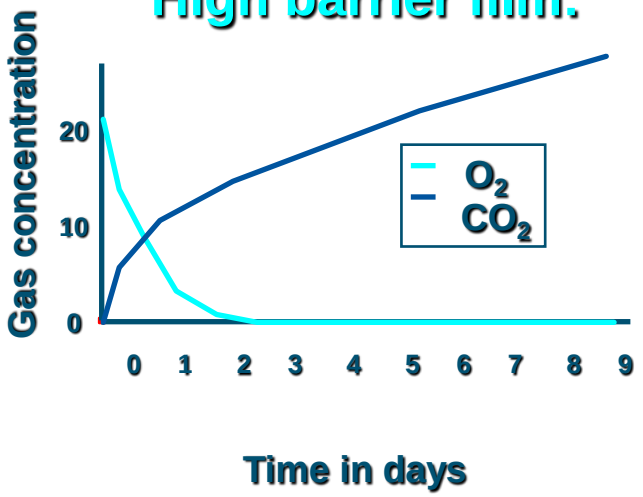
**Optimal packaging = perfect match between product requirements and packaging properties**

# Product requirements

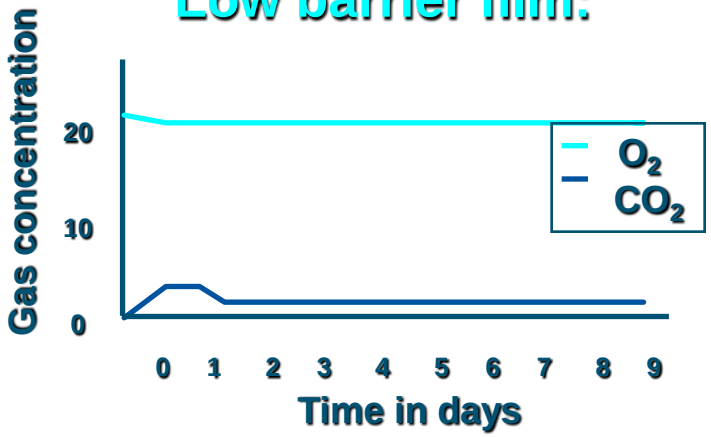
| Berry type | $O_2$ (%) | $CO_2$ (%) | Temperature |
|---|---|---|---|
| **Blueberries** | 5-10 | 15-20 | -0.5-0°C |
| **Raspberries** | 6-8 | 17 | -0.5-0°C |
| **Strawberries** | 5-8 | 10-13 | 0-1°C |
| **Blackberries** | 5-10 | 15-20 | 0-5°C |
| **Cranberry** | 1-2 | 0-5 | 2-4°C |
| **Redcurrant** | 2 | 18-20 | 1°C |

# The match: E-MAP technology

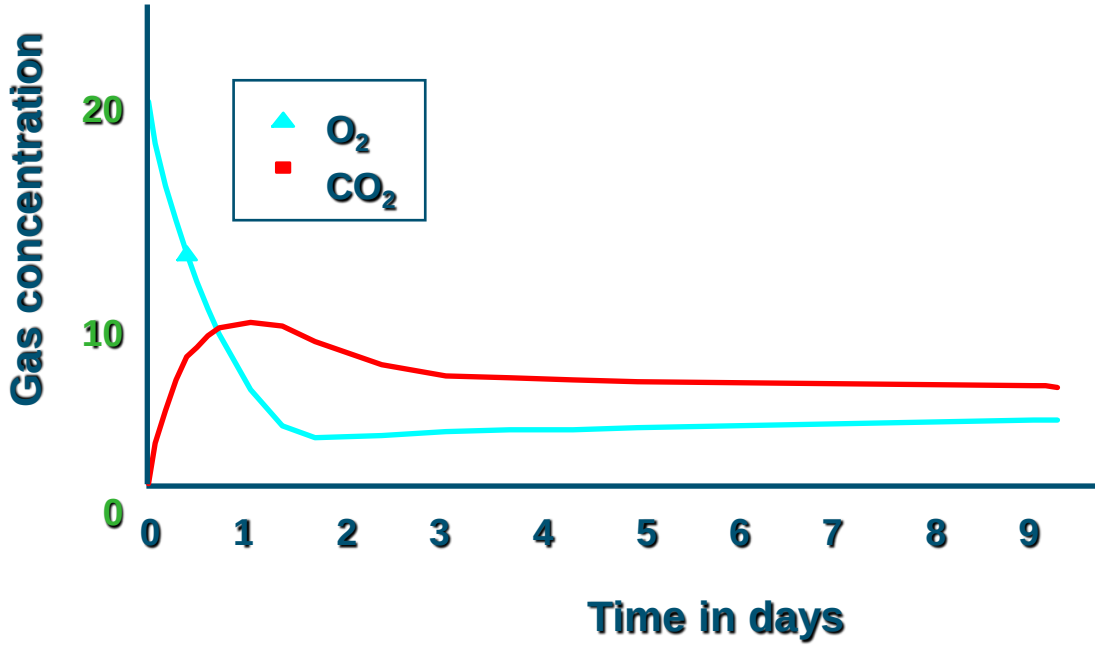
## High barrier film:




## Low barrier film:




## Optimal film (specific for each product)




FOOD & BIOBASED RESEARCH
WAGENINGEN UR

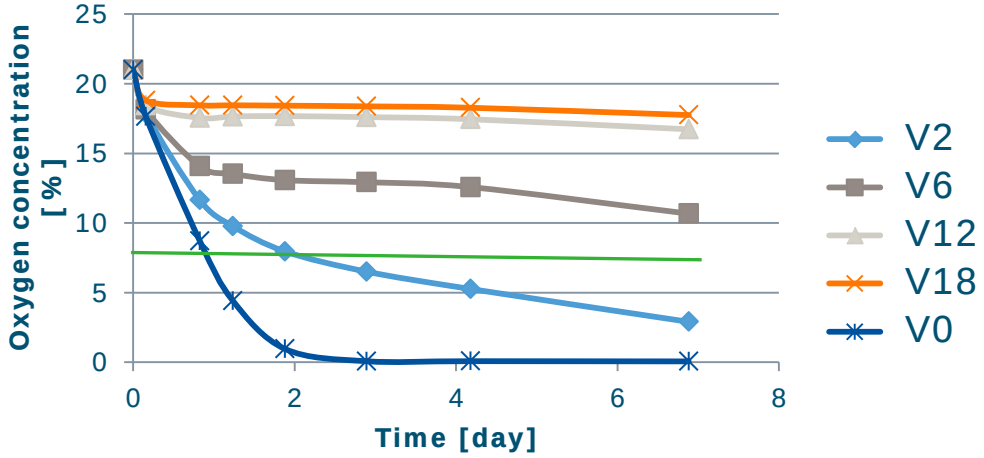
EUBerry

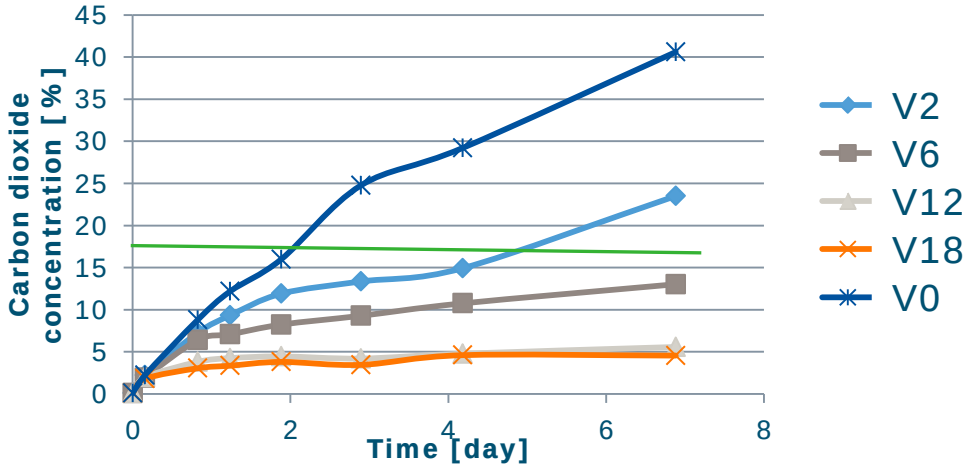
# Packaging design: what is the optimal number of perforations?

**Objective: achieve equilibrium gas composition of 7 % $O_2$ + 17 % $CO_2$**

| | Material | Amount of micro-perforations (100 µm) |
|---|---|---|
| **Ref** | PP top lid with macro-perforation | - |
| **V0** | MMF folie | no perf |
| **V2** | MMF folie | 2 perf |
| **V6** | MMF folie | 6 perf |
| **V12** | MMF folie | 12 perf |
| **V18** | MMF folie | 18 perf |

# Packaging design: what is the optimal number of perforations?



# Packaging design

- 4 perforations of 100 µm diameter each
- Volume packaging : 590 ml
- Amount product: 140-150 gr raspberries
- Type film: OPP (thickness ± 30 µm)
- Temperature: 8°C

# Test alternative concepts

- MAP (air as initial gas composition) with 4 perforations
- MAP with lower $O_2$ concentration and higher $CO_2$ concentration (10 % $O_2$ and 15% $CO_2$) as initial head space gas composition
- MAP (air) with 4 perforations and with drip pad (better moisture control)
- Active packaging (anti-microbial compound): 2-nonanone and 2-hexenal

# Test set up

- Cultivars from SantOrsola (Italy):
  - Lagorai
  - Tulameen
- Pre-treatment
  - Lagorij without and with ozone for (1 ppm during 24 h; temperature: 3.5°C; RH: 80-90%)
  - Tulameen batch with ozone
- Storage conditions: 8°C; RV 80-90%
- Reference package: PP clamshell with macro perforations

EUBerry

# Quality parameters assessed

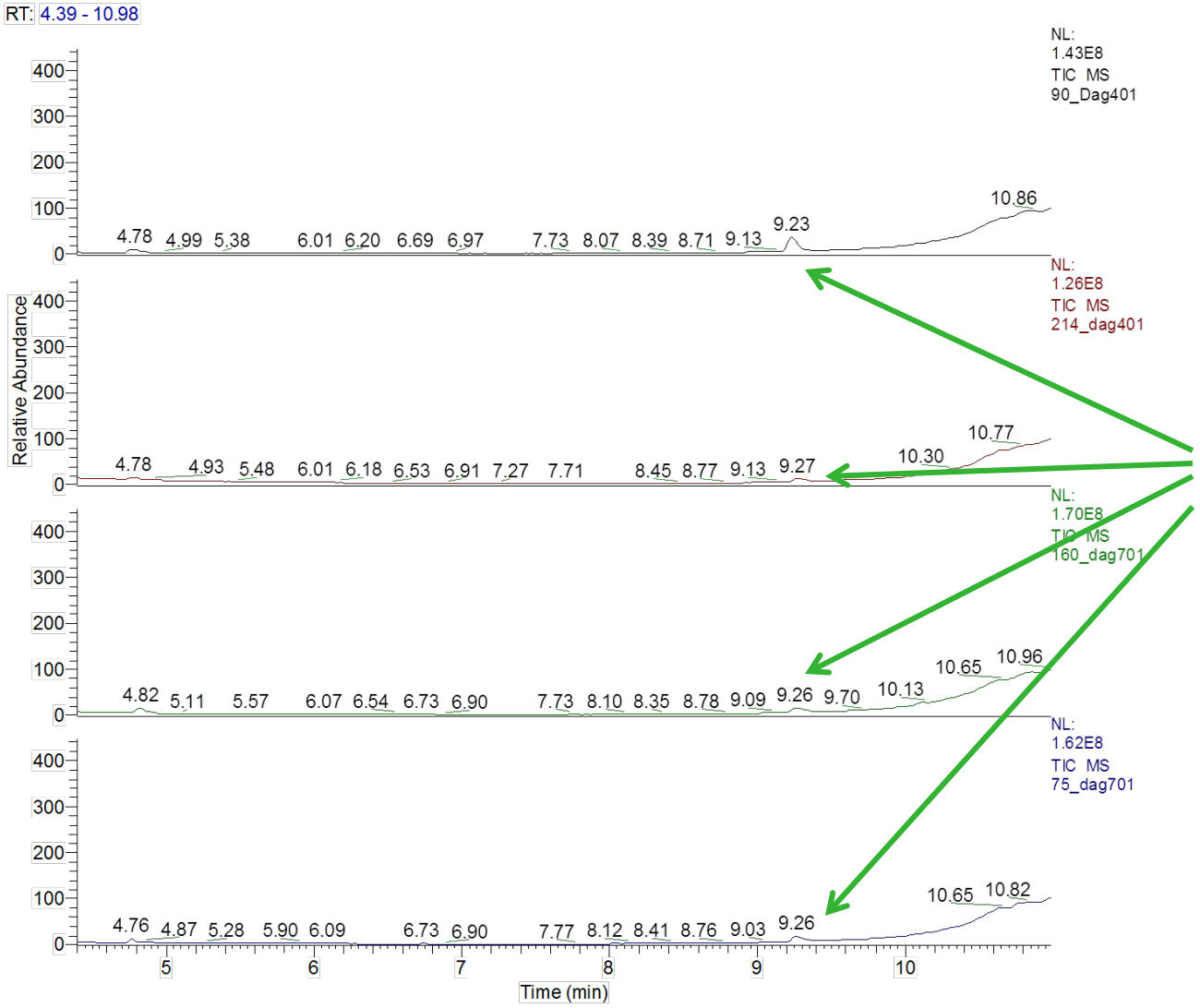
- Gas composition head-space (Dansensor)
- Weight losses (balance)
- General impression (visual)
- Drip (visual)
- Smell by opening of the package (sensorial)
- Colour (visual)
- Mould growth (visual)
- Taste (sensorial)

# Quality measurements

- At 1, 4 and 6 days

- After 8 days:
  - Sensorial evaluation of reference, active packaging with 2-hexenal and MAP (air) with drip pad;
  - Gas composition of all samples.

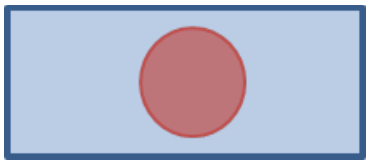
# GC measurement head-space (after 4 days)




**2-Nonanone**

2-hexenal could not be measured

*Slow release systeem:*

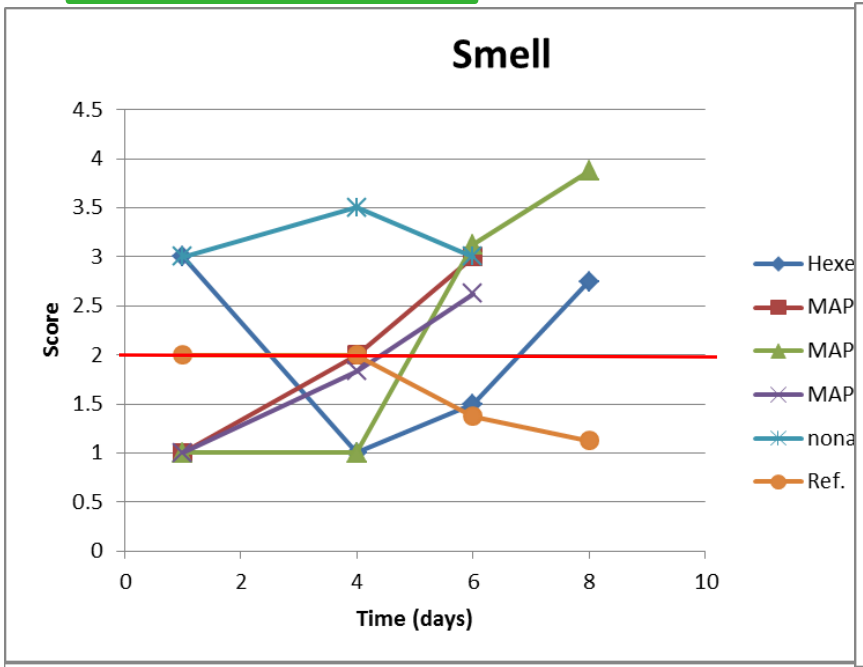


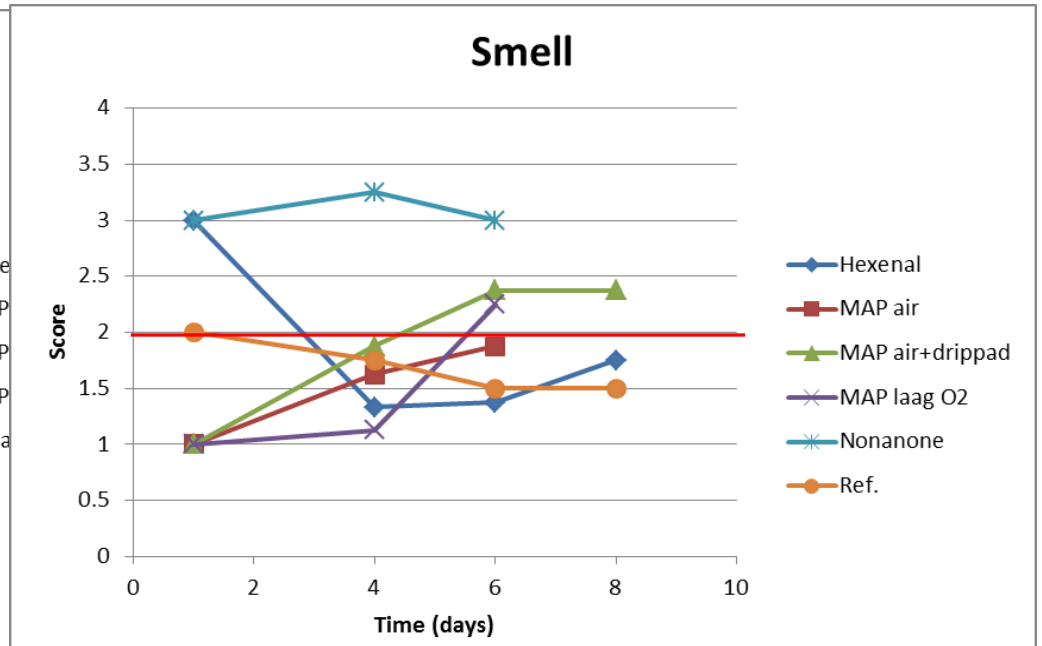
FOOD & BIOBASED RESEARCH
WAGENINGEN UR

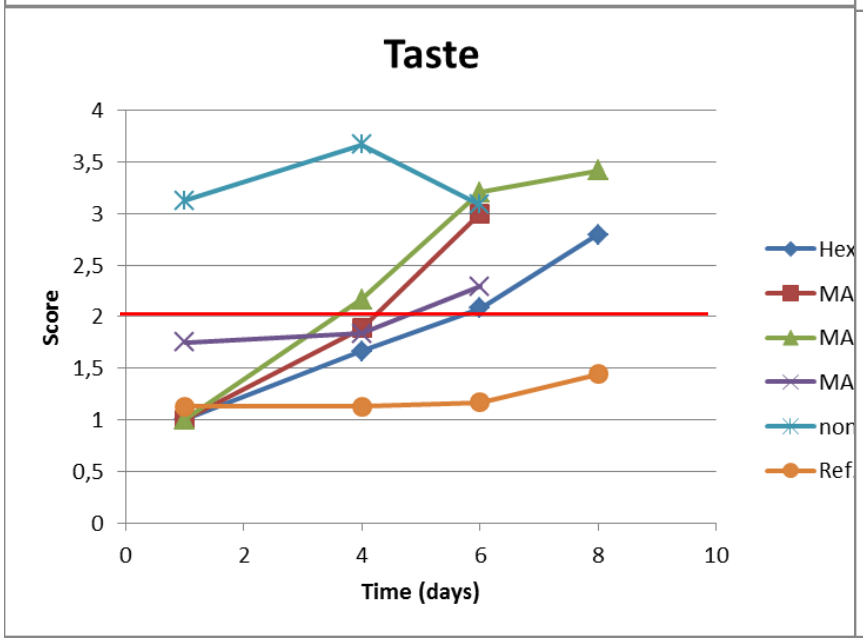
# Smell and taste

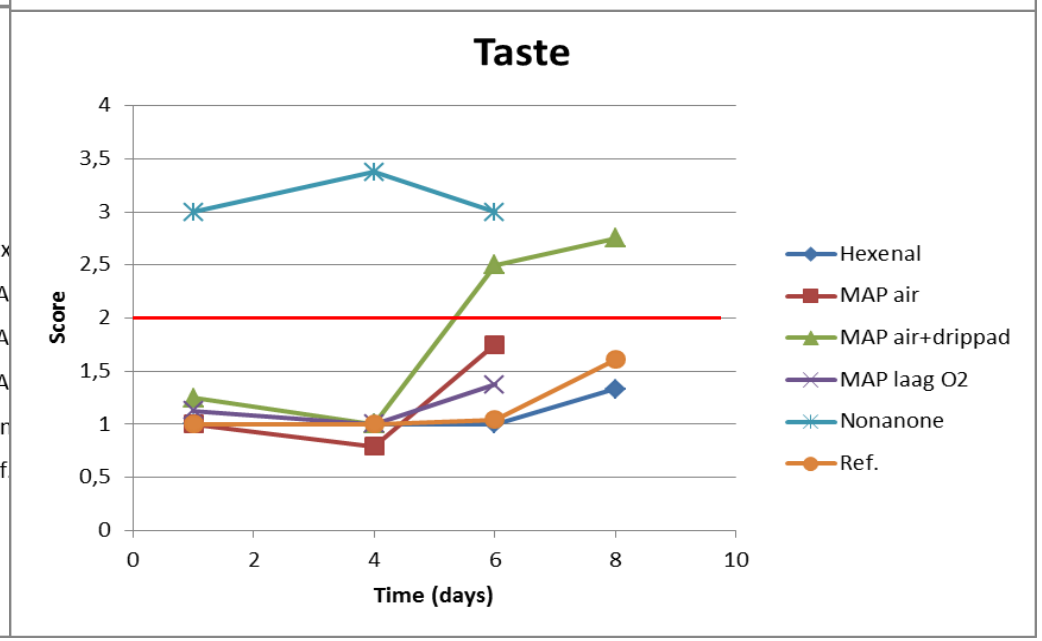
Lagorij

Tulameen



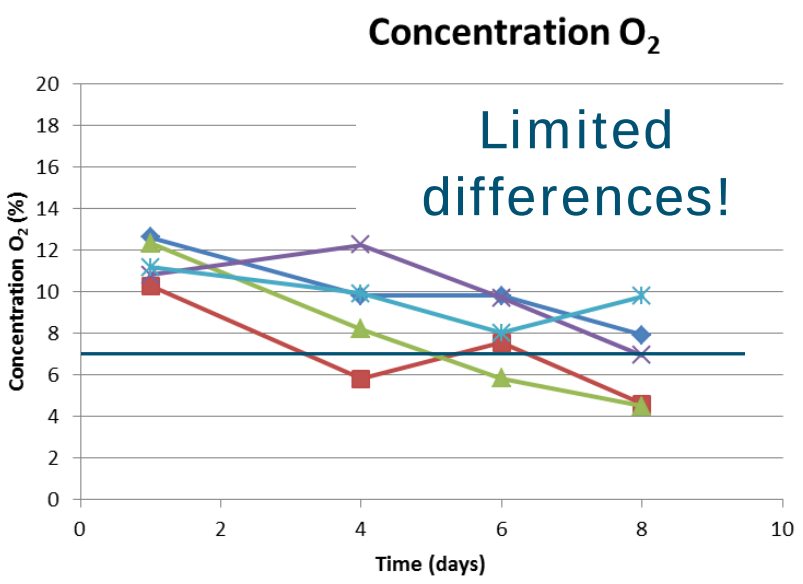



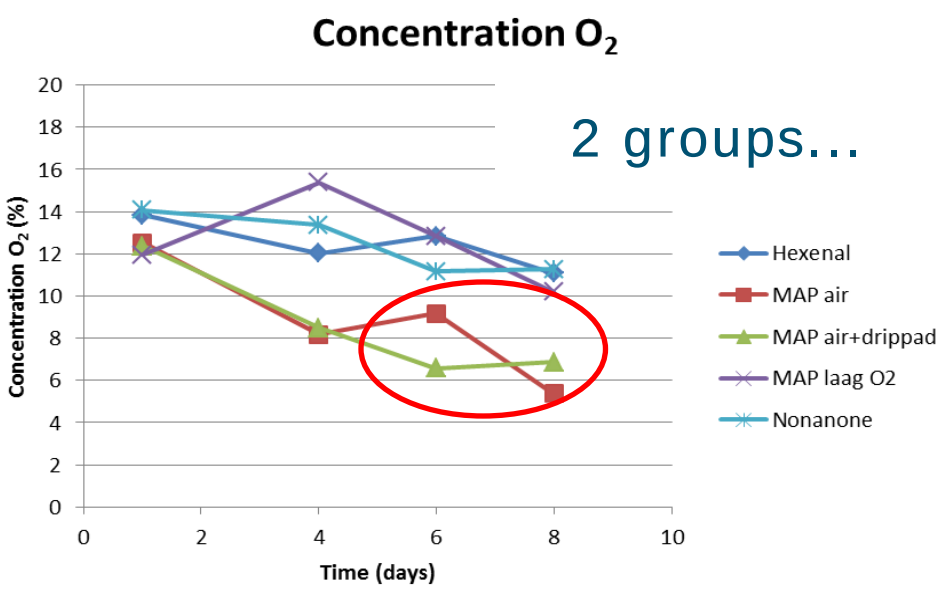



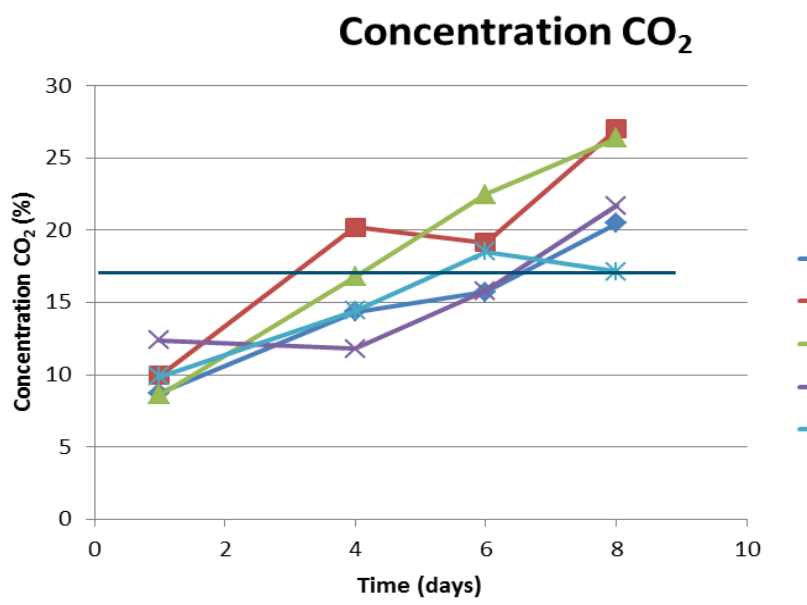
# Gas composition

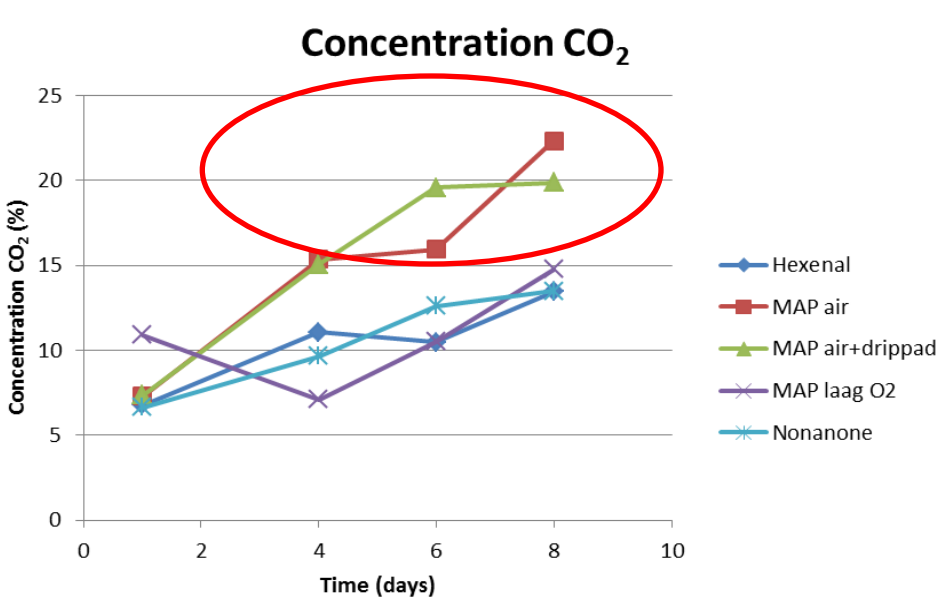
Lagorij

Tulameen



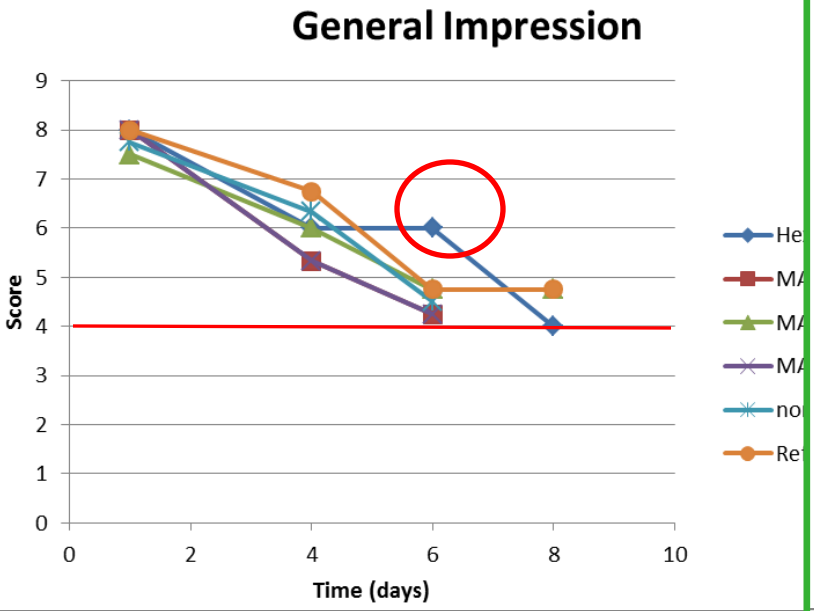



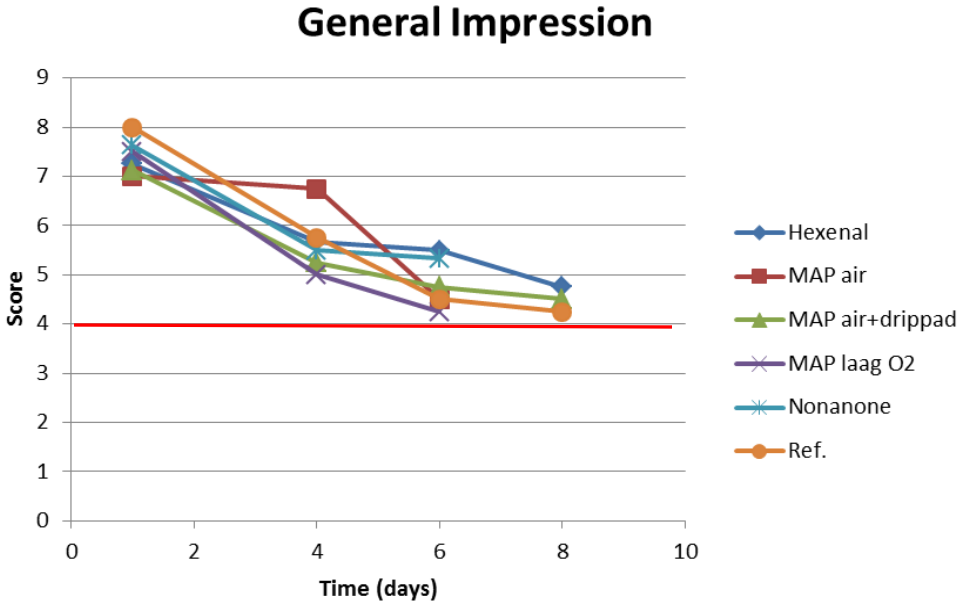



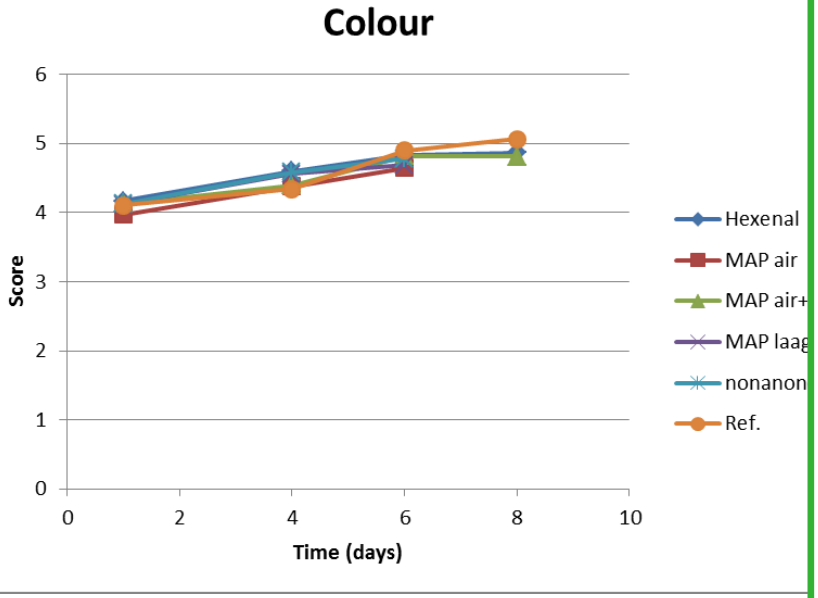
# G.I. and colour

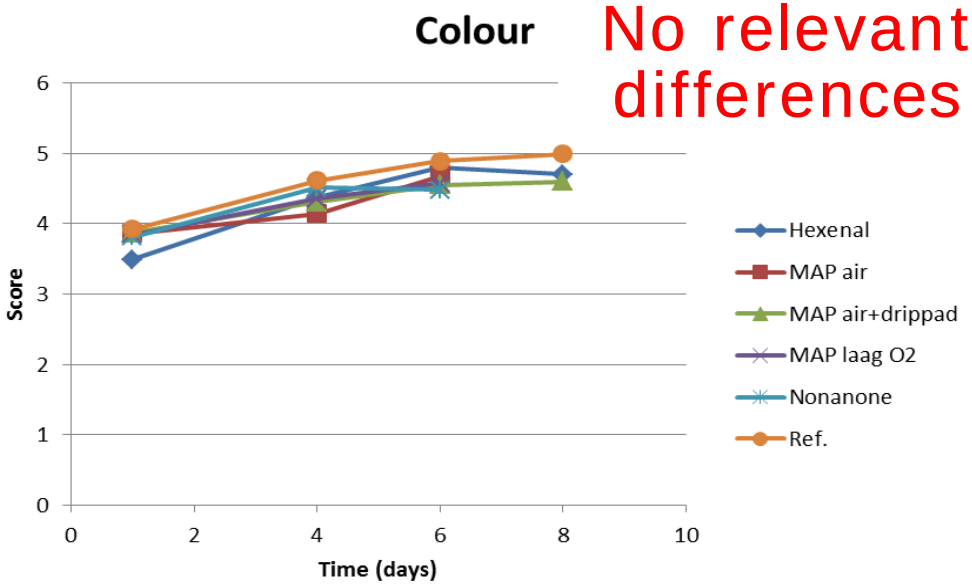
Lagorij

Tulameen



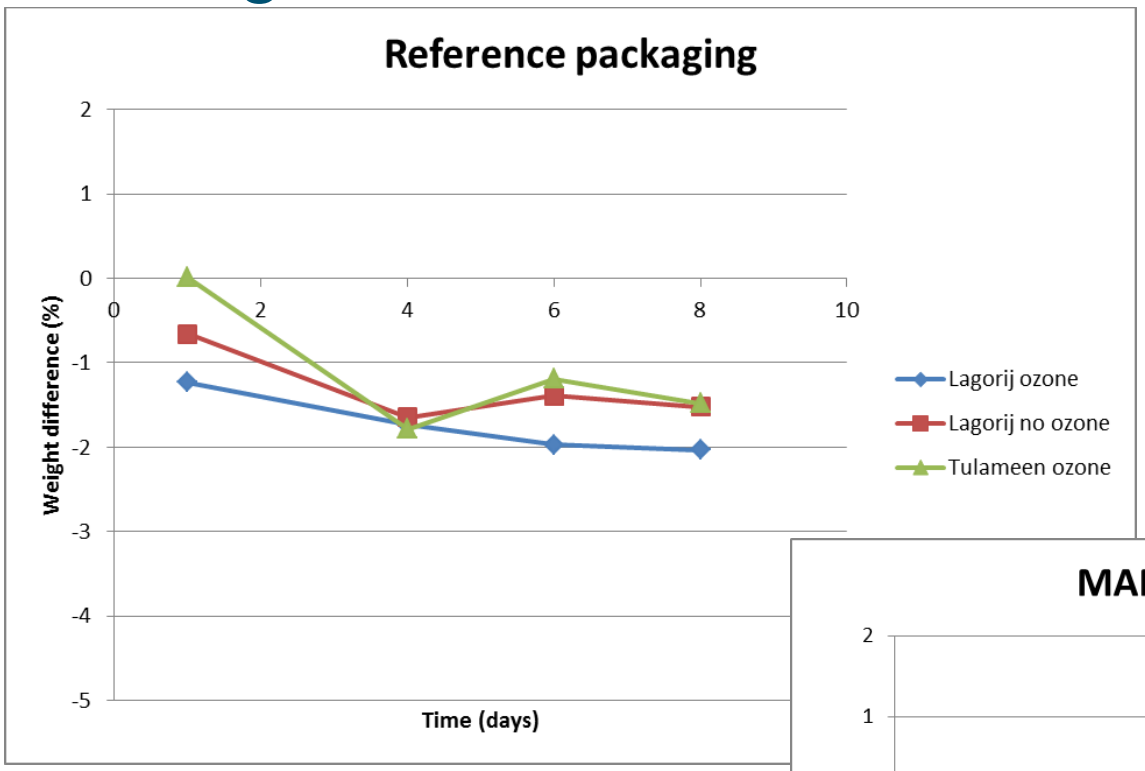



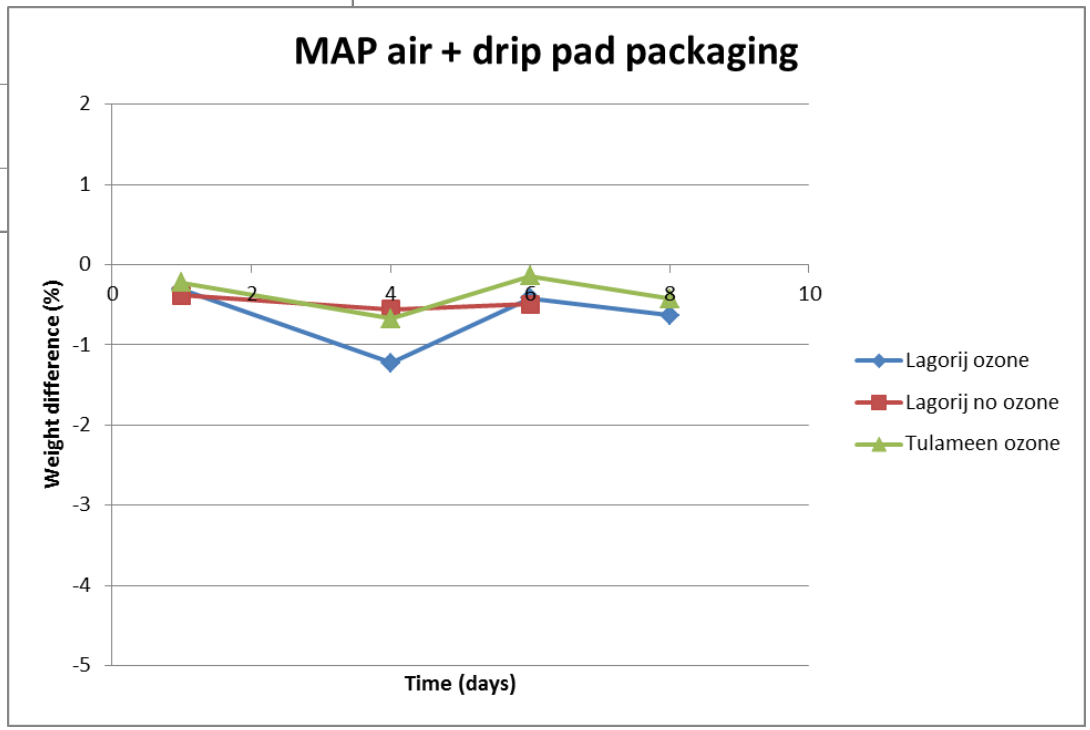



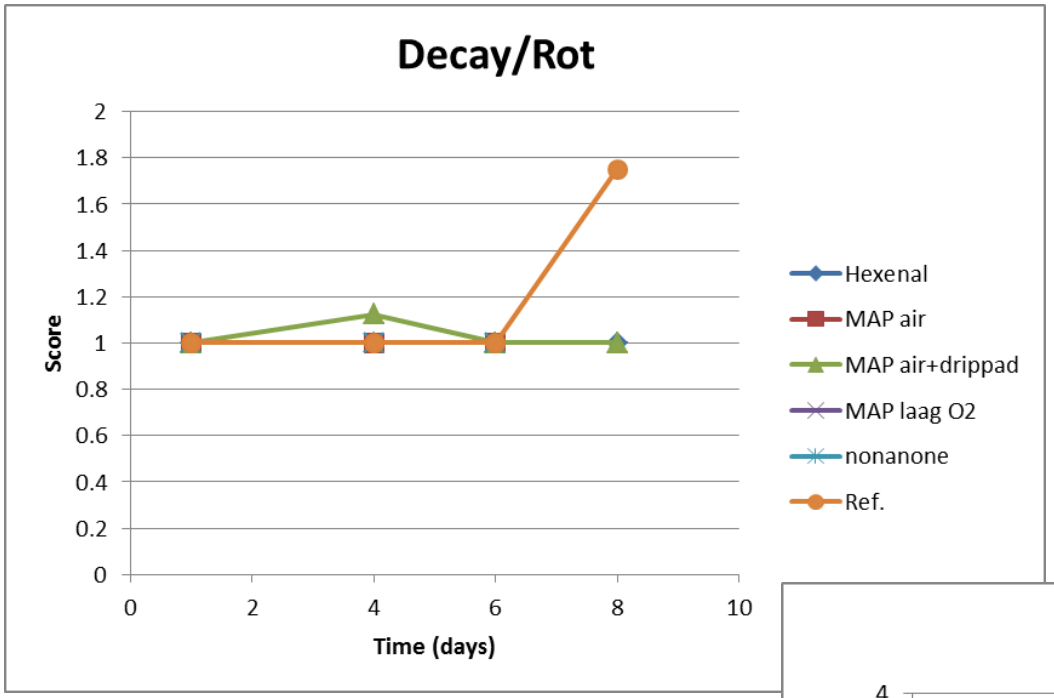

No relevant differences

# Weight losses

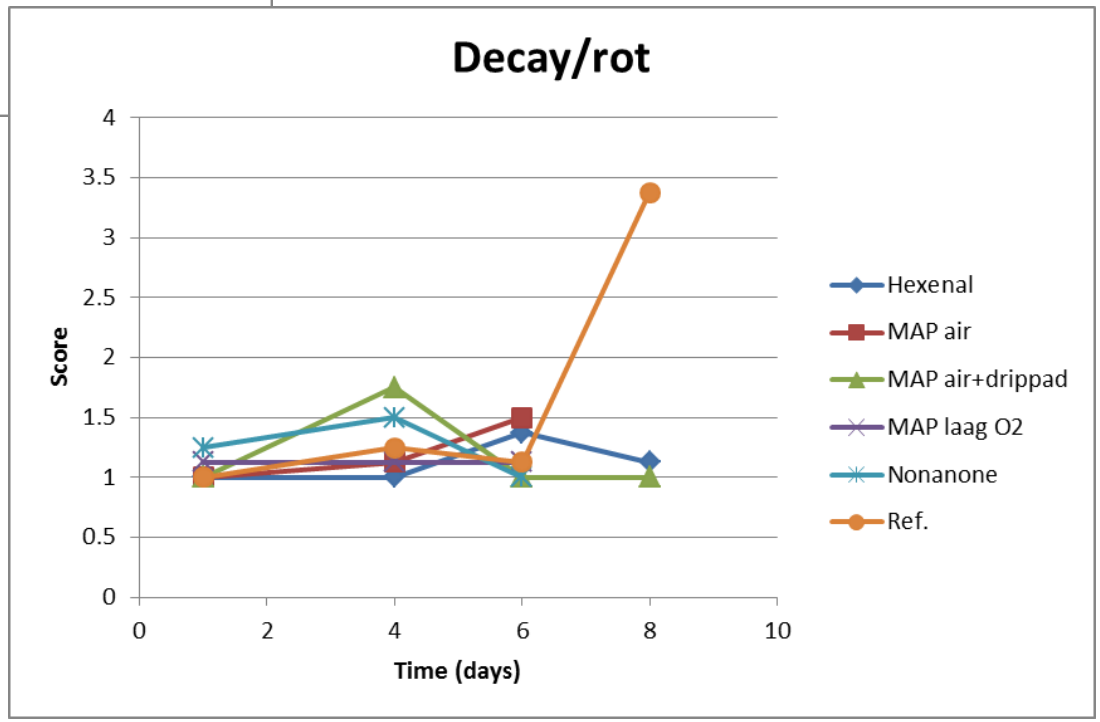


# Lagorij




## Tulameen

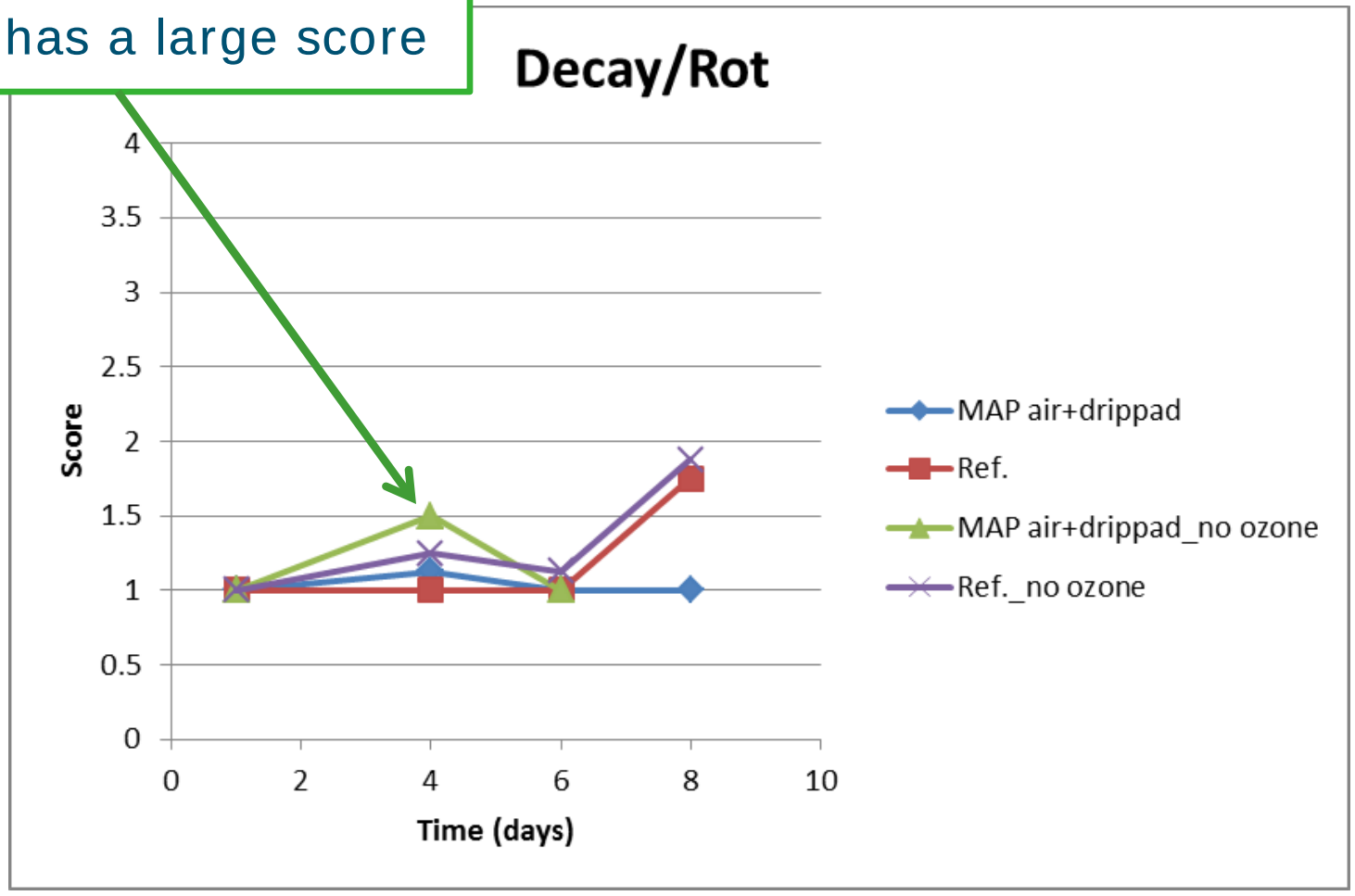



Tulameen shows more mould growth; already at day 1!

FOOD & BIOBASED RESEARCH
WAGENINGEN UR

# Lagorij: Ozone vs. no ozone

1 out 4 has a large score



# Conclusions

- Difference in respiration rate between the 2 cultivars (Lagorij higher respiration rate)
- Tulameen: shelf life is 8 days with 2-hexenal packaging
- Lagorij: shelf life is 6 days (at day 8 there is too much mould growth OR off-odours/tastes)
- Light off-odour by opening of the packages; afterwards no off-odour due to the 2-hexenal itself though
- Packages with 2-nonane are not acceptable due to the strong smell of the 2-nonanone self

# Conclusions

- Significant more rot by reference packages than by MAP packages (at day 8)
- Ozone treatment does not seem to have effect on the mould growth (rot) by Lagorij
- The amount of drip was limited for all package concepts
- The reference packages showed the highest weight losses (between 1.5 – 2%)
- There isn't less drip or mould growth on the packages with drip pad when compared to the ones without drip pad

Journal of Berry Research 3 (2013) 93–102
DOI:10.3233/JBR-130050
IOS Press

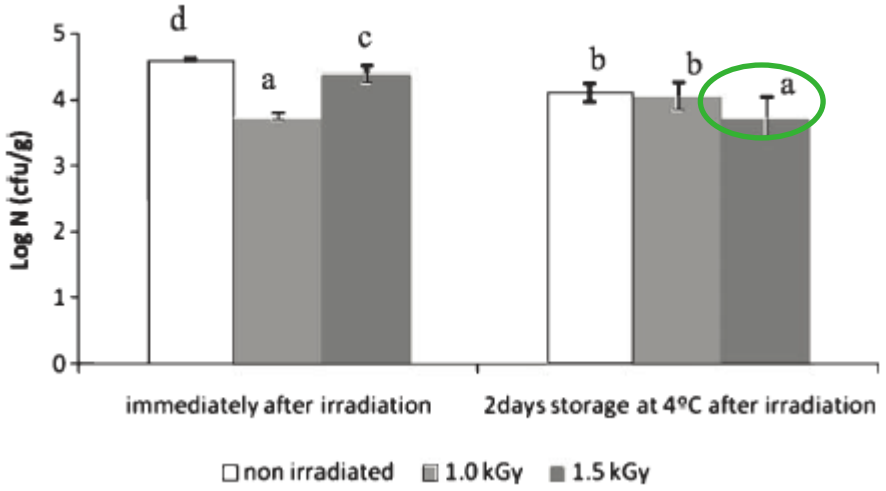


# Evaluation of potential of gamma radiation as a conservation treatment for blackberry fruits

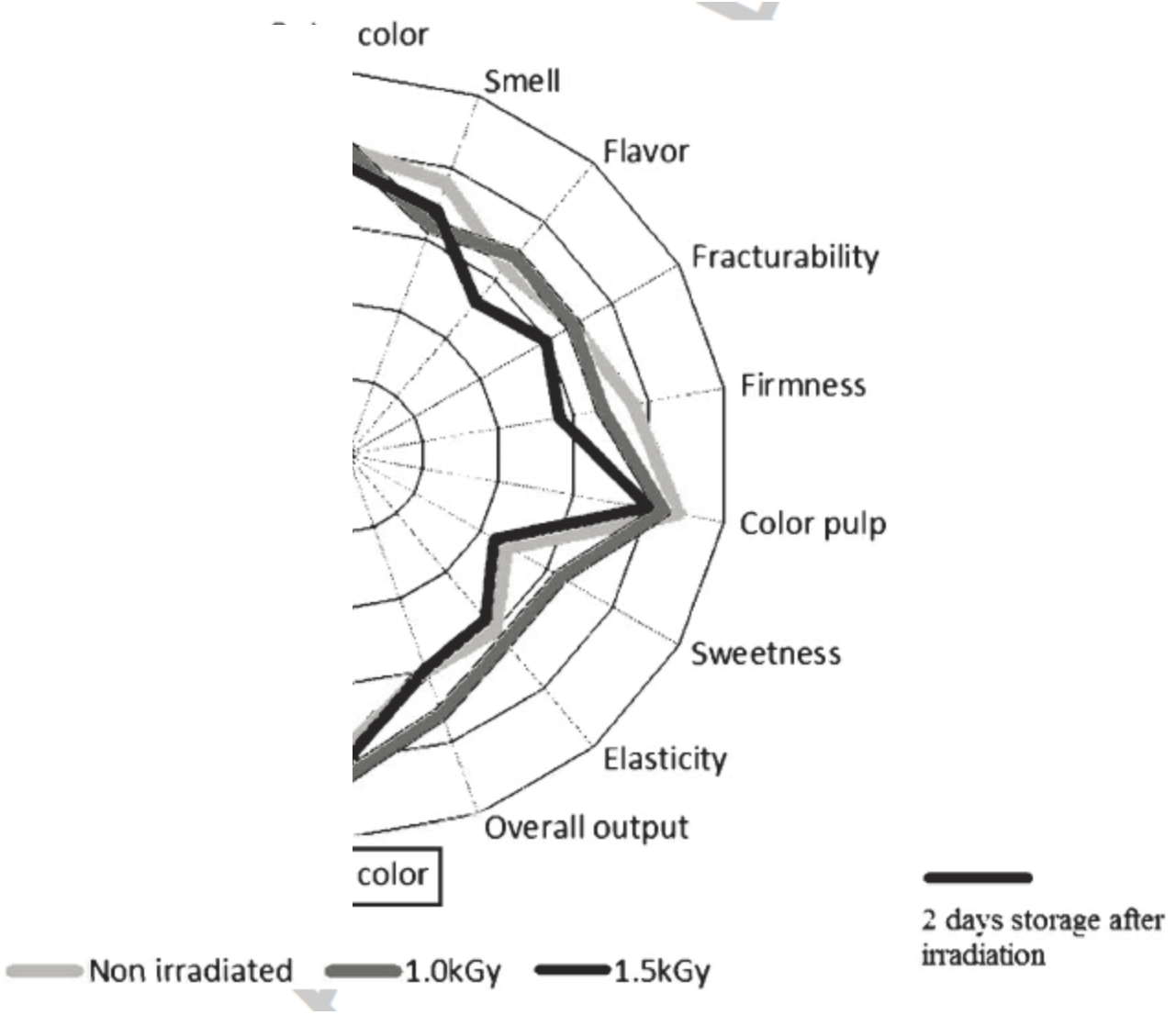
M. Oliveira[a,b], J. Pereira[b], S. Cabo Verde[b,*], M.G. Lima[a], P. Pinto[a,c], P.B. de Oliveira[d], C. Junqueira[b], H. Marcos[b], T. Silva[b], R. Melo[b], C.N. Santos[c,e] and M.L. Botelho[b]

Table 2
Frequency of the morphological phenotypes of the isolates from non-irradiated and irradiated blackberries with storage time ($n = 428$ isolates from samples immediately after irradiation; $n = 166$ isolates from samples with 2 days storage after irradiation)

| | % of total microbiota | | |
|---|---|---|---|
| | Dose (kGy) | | |
| Phenotypical typifcation | Non irradiated | 1.0 | 1.5 |
| *Immediately after irradiation* | | | |
| *Gram* negative oxidase negative rods | 0.00 | 0.00 | 0.00 |
| Yeast | 0.00 | 15.49 | 60.32 |
| Filamentous fungi | 100.00 | 84.51 | 39.68 |
| *2 days storage after irradiation* | | | |
| *Gram* negative oxidase negative rods | 0.00 | 0.00 | 3.23 |
| Yeast | 20.00 | 32.35 | 41.94 |
| Filamentous fungi | 80.00 | 67.65 | 54.83 |




| Sample | L* ± SD | TSS (° Brix) at 24°C (Mean ± SD) | Firmness ± SD |
|---|---|---|---|
| *Immediately after irradiation* | | | |
| Non irradiated | $18.91^{abd} \pm 1.00$ | $9.56^{d} \pm 0.43$ | $0.13^{a} \pm 0.15$ |
| 1.0 kGy | $20.06^{ab} \pm 1.31$ | $9.06b^{c} \pm 0.24$ | $0.22^{a} \pm 0.10$ |
| 1.5 kGy | $19.76^{ab} \pm 1.10$ | $8.75^{ab} \pm 0.29$ | $0.15^{a} \pm 0.12$ |
| *2 days storage after irradiation* | | | |
| Non irradiated | $17.47^{cd} \pm 1.05$ | $9.25^{cd} \pm 0.35$ | $0.41^{b} \pm 0.18$ |
| 1.0 kGy | $16.79^{c} \pm 0.63$ | $10.00^{e} \pm 0.00$ | $0.17^{a} \pm 0.05$ |
| 1.5 kGy | $18.57^{acd} \pm 1.17$ | $8.63^{a} \pm 0.32$ | $0.21^{a} \pm 0.11$ |


color
Smell
Flavor
Fracturability
Firmness
Color pulp
Sweetness
Elasticity
Overall output
color
2 days storage after irradiation
Non irradiated
1.0kGy
1.5kGy

# Gamma irradiation

- 1.5Gy can reduce microbial contamination 1 log
- No/marginal effect on colour, brix, taste etc
- Slight increase overall output
- Significant increased days shelf life in practise ?

Not tested

- Irradiation allowed for fresh products ?

Directive 1999/2/EC – general - approximating EU countries' laws;

Directive 1999/3/EC - implementing - EU list of irradiated food and food ingredients;

EU countries must use validated or standardised analytical methods to detect irradi

**Foods & food ingredients authorised for irradiation in the EU**

Currently, these are:

- Fruit and vegetables including root vegetables;

In Nederland wordt vers fruit en verse groenten niet doorstraald. Doorstraling van voedsel mag alleen bij producten waarvoor ontheffing is verleend. Voor elk van die producten is bepaald welke maximale dosis straling opgenomen mag worden. Zie hiervoor de onderstaande tabel.

| **Voedingsmiddel of grondstof** | **Maximale gemiddelde dosis (kiloGray)** |
|---|---|
| Gedroogde vruchten | 1 |

| Product | Authorised at the given maximum overall average absorbed radiation dose (kGy) | | | | | | |
|---|---|---|---|---|---|---|---|
| | BE | CZ | FR | IT | NL | PL | UK |
| Fruit (incl. fungi, tomato, rhubarb) | 2 | 2 | | | | | 2 |
| Strawberries | 2 | 2 | | | | | |
| Dried vegetables and fruits | 1 | 1 | 1 | | 1 | | |

# Thank you for your attention



FOOD & BIOBASED RESEARCH
WAGENINGEN UR

EUBerry
EUBerry