

Matrix and preservation technology dependent stability and bioaccessibility of strawberry anthocyanins during storage

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1

Background – Market growth & Anthocyanins

2

Materials and Methods – Processing & Analyses

3

Results - Anthocyanin kinetics during storage and Bioaccessibility

4

Conclusion



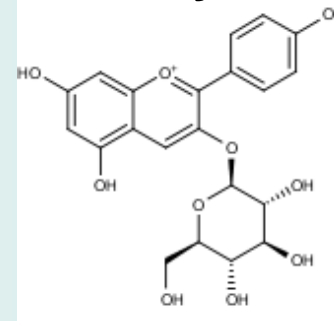
Functional Food is major trend influencing the food sector by 2035 ¹

European **smoothie market grows** at CAGR of **6.8 %** by 2025 ²

¹ Moller, B., Voglhuber-Slavinsky, A., Dönitz, E., & Rosa, A. (2019). *50 trends influencing Europe's food sector by 2035*

² Market Data Forecast. (2020). *Europe Smoothies Market*.

Anthocyanins



Health benefits



Degradation

FORMULATION

1. Strawberry-Kale-Mix



2. Strawberry-Water-Mix



Ratio 1:1
pH 4

PROCESSING



Thermal

Temperature	72 °C
Time	60 s



Pulsed Electric Field

Temperature _{in}	35 °C
Temperature _{out}	58 °C
Electric field strength	11.2 kV/cm
Specific energy	120 kJ/l

HVP 5 kW Elea®
DIL, Germany



HPP

Pressure	600 MPa
Time	1 min
Temperature	RT

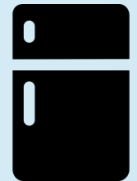
HPP Wave 6000/55
Hiperbaric, Spain



Control (untreated)

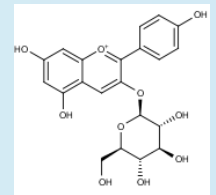
STORAGE

4 °C for 42 days



ANALYSES

Anthocyanins
(HPLC-DAD)

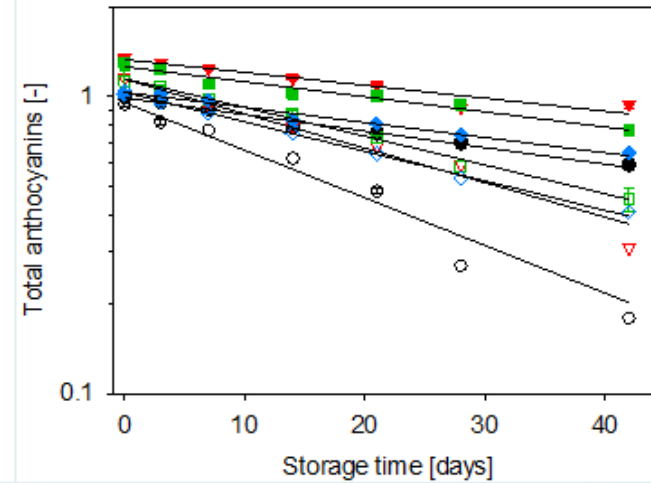
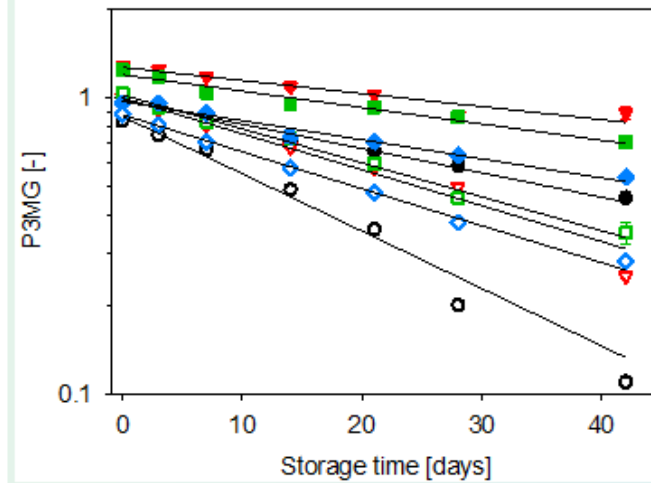
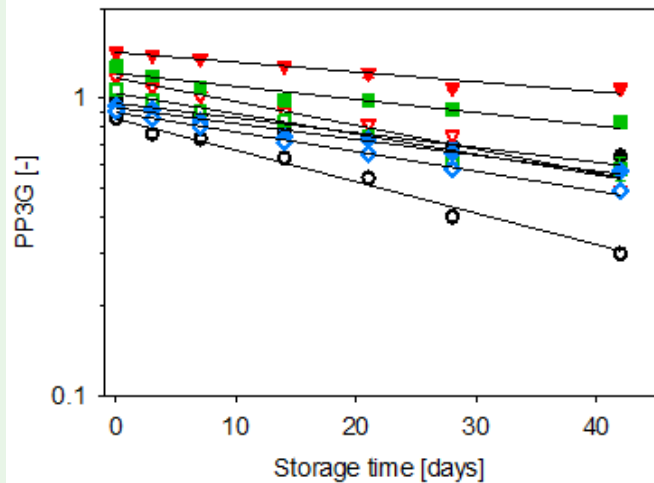
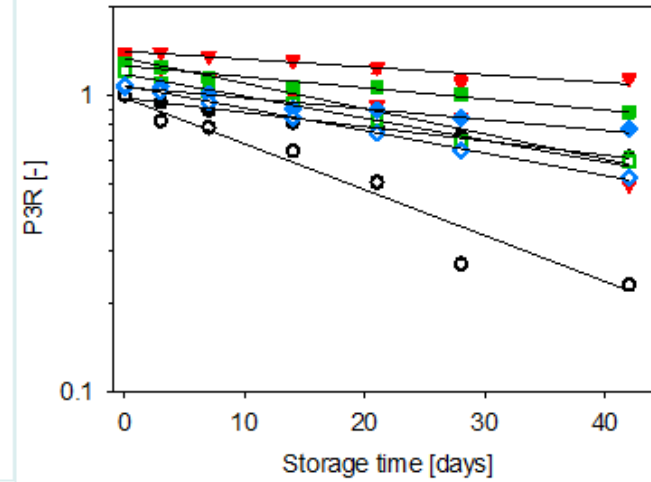
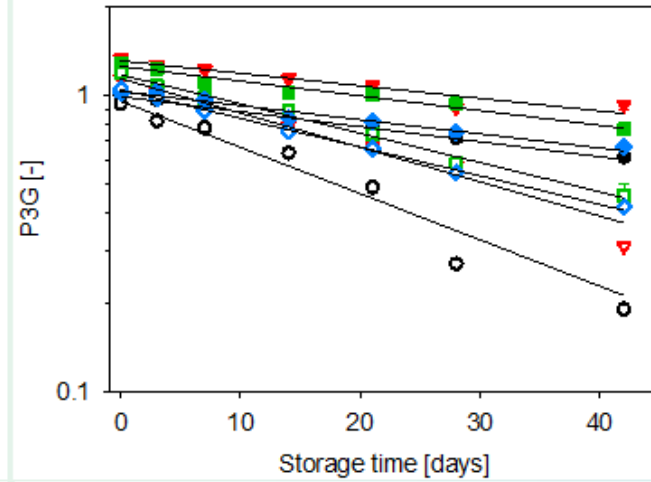
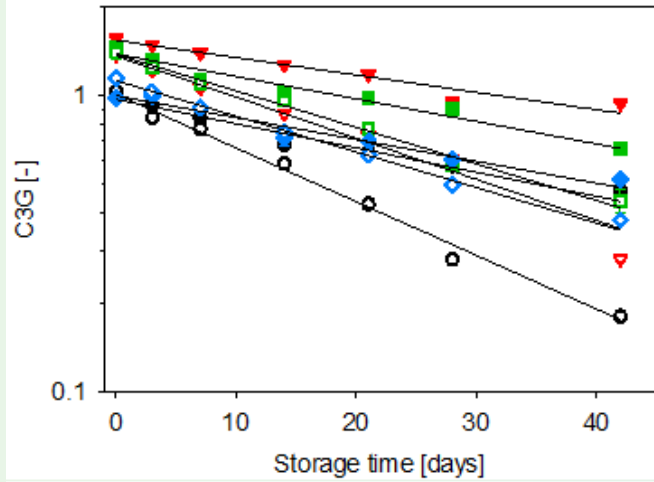


Bioaccessibility
of anthocyanins
during *in-vitro*
digestion



3 RESULTS

ANTHOCYANIN KINETICS DURING STORAGE



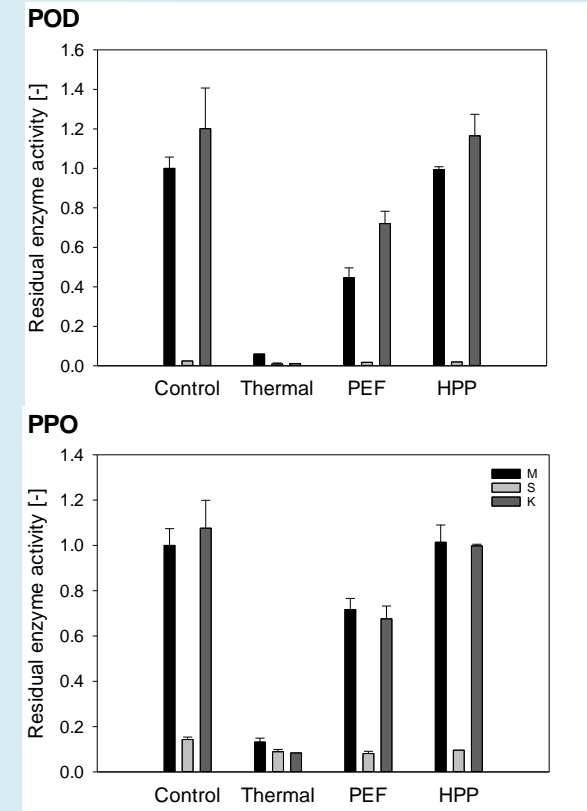
$$c = c_0 \cdot e^{-kt}$$

Strawberry-kale (empty)
Strawberry-water (filled)

- Control
- Control
- ▼ Thermal
- ▽ Thermal
- PEF
- PEF
- ◆ HPP
- ◇ HPP

Degradation rate constant (k)

- Higher for strawberry-kale-mix compared to strawberry-water
→ oxidative enzyme activity originating from kale
- Processing decreased degradation rate constant
- Structure dependent degradation rate constant
 - Cyanidin vs. Pelargonidin: hydroxyl group at B-ring
 - Pelargonidin-glucoside vs. P-malonyl-g: malonyl moiety
 - Glucoside vs. Rutinoside: saccharide size
 - Pyranoanthocyanins: stable and built during storage



Bioaccessibility (BA): available fraction for absorption
(ratio of respective sample before digestion)

Gastric BA

- Increased (> 1) due to low pH during gastric phase
- Thermal and PEF > Control and HPP
→ increased extraction due to temperature effect
- Higher for strawberry-kale compared to strawberry-water
→ increased released from possible complexes
- Higher after storage → polymerization of anthocyanins

Intestinal BA

- Regardless of formulation, processing and storage
- Relatively low in a range of 20-30 %

			After processing	After storage
Strawberry -water	Control	G	1.11 ± 0.02 ^b	-
		I	0.27 ± 0.01 ^{cd}	-
	Thermal	G	1.10 ± 0.02 ^b	1.15 ± 0.01 ^c
		I	0.19 ± 0.01 ^e	0.14 ± 0.00 ^d
	PEF	G	1.13 ± 0.02 ^b	1.21 ± 0.02 ^c
		I	0.30 ± 0.01 ^{ab}	0.24 ± 0.00 ^b
	HPP	G	1.14 ± 0.01 ^b	1.30 ± 0.01 ^c
		I	0.24 ± 0.01 ^d	0.20 ± 0.00 ^{bc}
Strawberry -kale-mix	Control	G	1.27 ± 0.02 ^a	-
		I	0.28 ± 0.01 ^{bc}	-
	Thermal	G	1.25 ± 0.01 ^a	2.17 ± 0.18 ^a
		I	0.19 ± 0.01 ^e	0.19 ± 0.03 ^c
	PEF	G	1.27 ± 0.03 ^a	2.17 ± 0.04 ^a
		I	0.32 ± 0.01 ^a	0.40 ± 0.02 ^a
	HPP	G	1.29 ± 0.02 ^a	1.81 ± 0.03 ^b
		I	0.26 ± 0.01 ^{cd}	0.20 ± 0.02 ^{bc}

Processing
Formulation (including kale)
Anthocyanin structure



Strong effect on stability and gastric bio-availability of anthocyanins during storage

Outlook

- Development of products with improved nutritional quality
→ processing and matrix interactions to be considered



Thank you for your attention!

DIL German Institute of Food Technologies

Advanced Technologies

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