

Innovative Approaches to Retain Bioactives during Berry Processing and Storage

Luke R. Howard, Ph.D.
Department of Food Science
University of Arkansas



Berries and Health Promotion

Prevention of Chronic Diseases

CHD & stroke

Cancer

Neurological disorders

Obesity

Type II diabetes

Mechanisms

Antioxidant

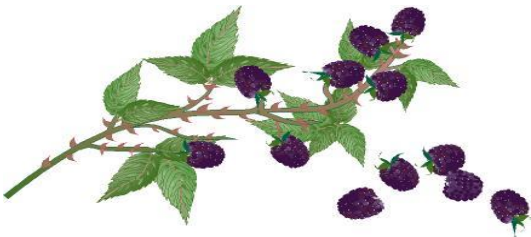
Anti-inflammatory

Cell signaling

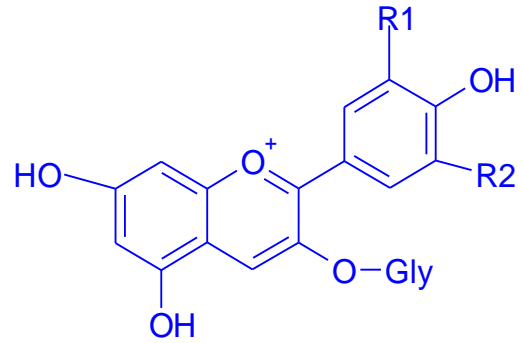
Gene regulation

Apoptosis

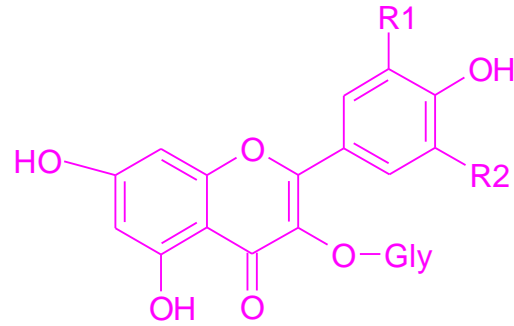
Modulation of enzymes



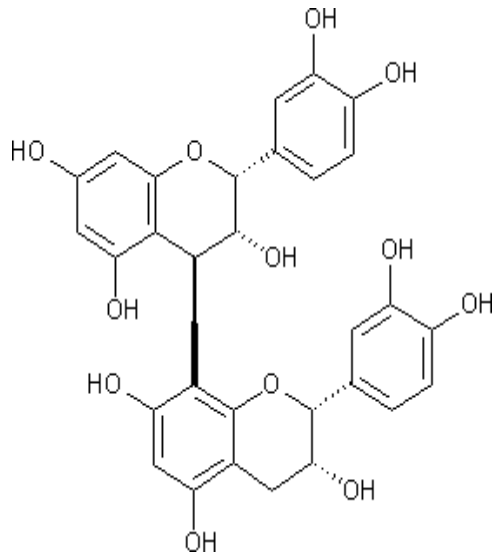
Berry Polyphenols



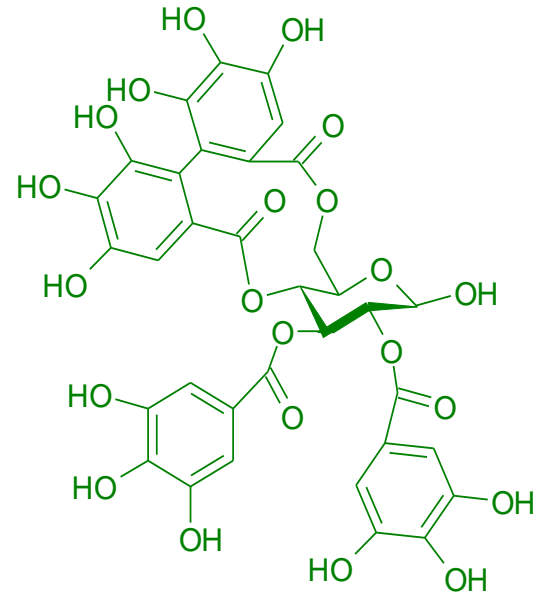
Anthocyanins



Flavonols

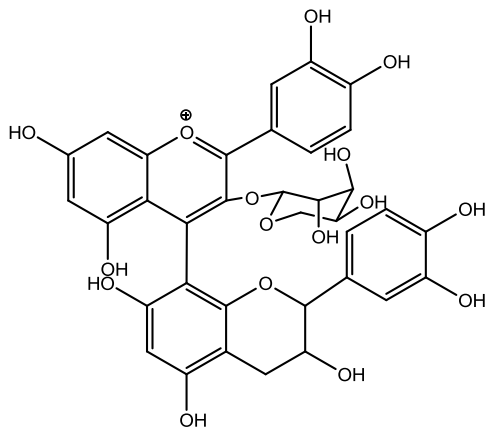


Procyanidins

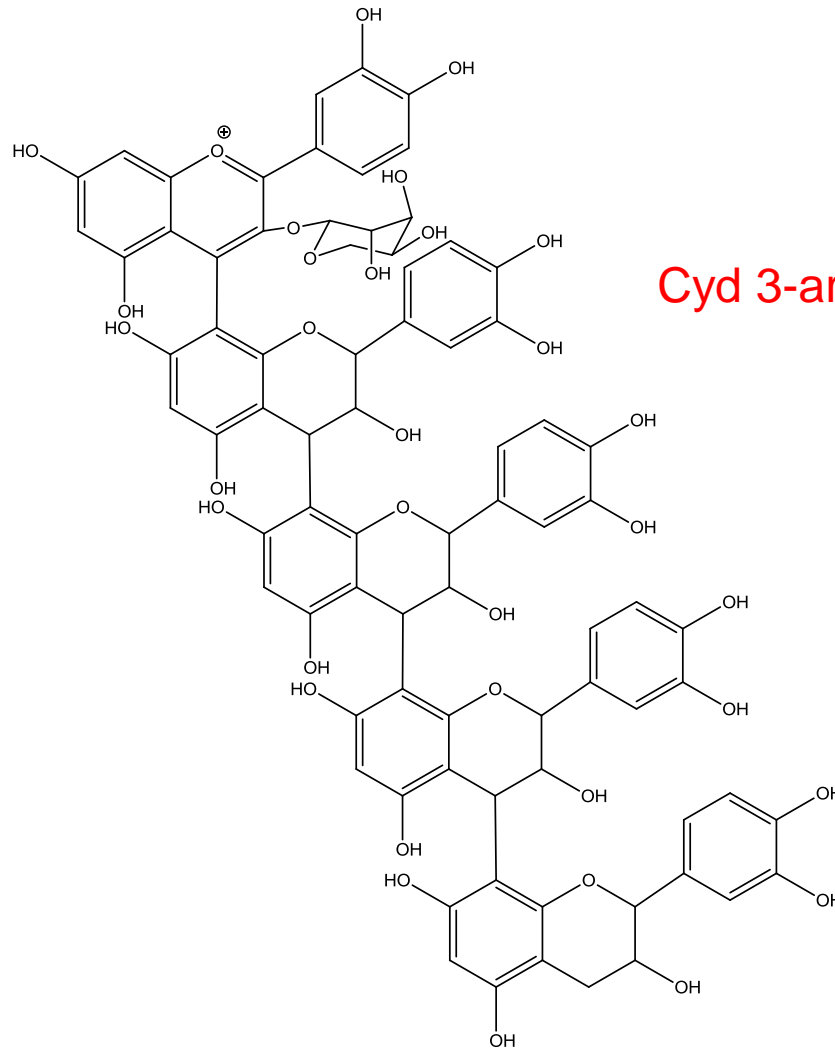


Ellagitannins

Anthocyanin-Procyanidin Polymers



Cyd 3-ara + 1 cat/epi

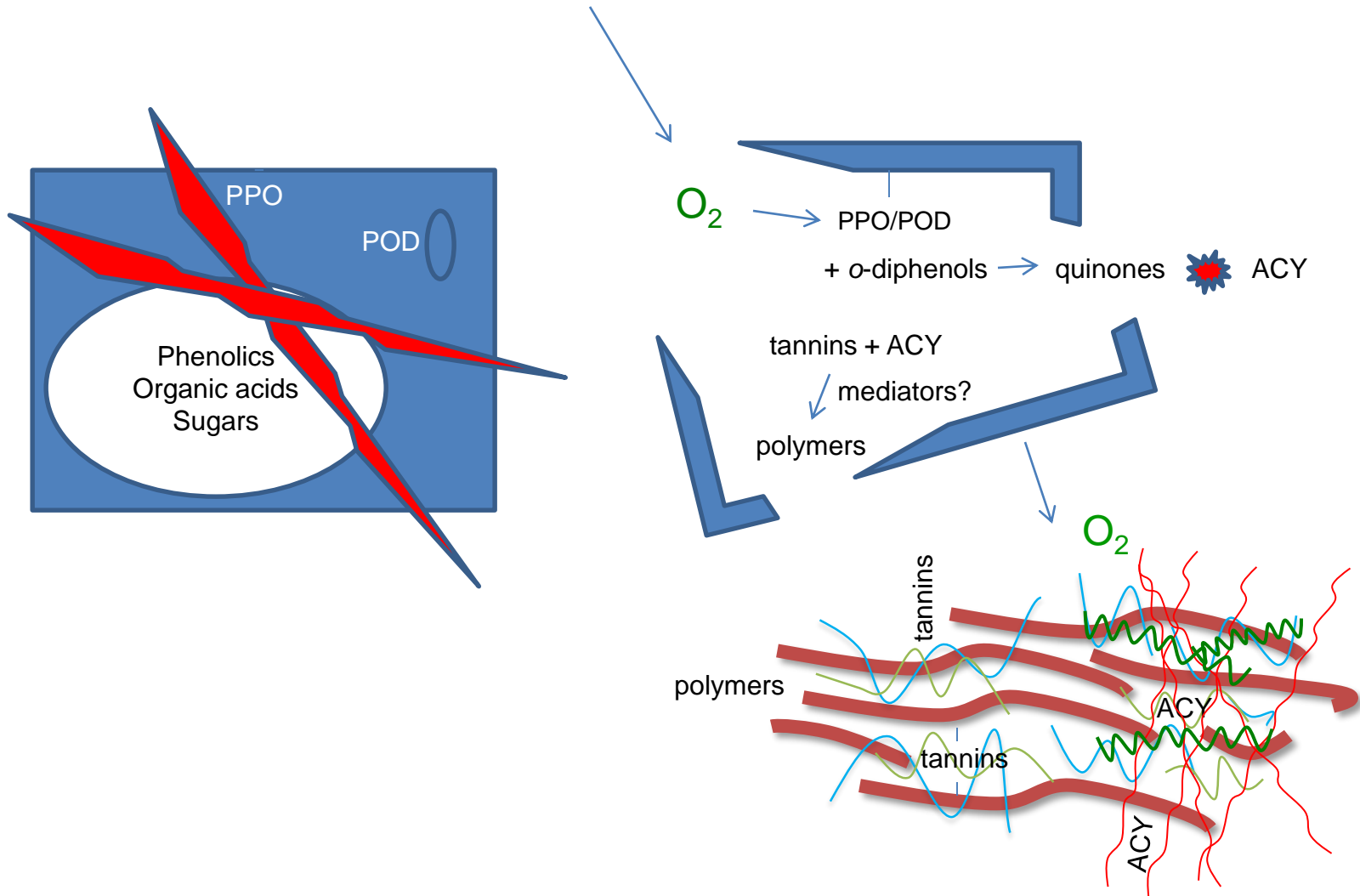


Cyd 3-ara + 4 cat/epi

Processing and Storage Effects on Berry Polyphenols

- Losses of polyphenols are inevitable during processing
 - ✓ Enzymes
 - ✓ Oxygen
 - ✓ Heat
 - ✓ Physical removal of tissues
 - ✓ Polymerization reactions
- Losses during storage can be more severe than those incurred during processing

Consequences of Cell Disruption



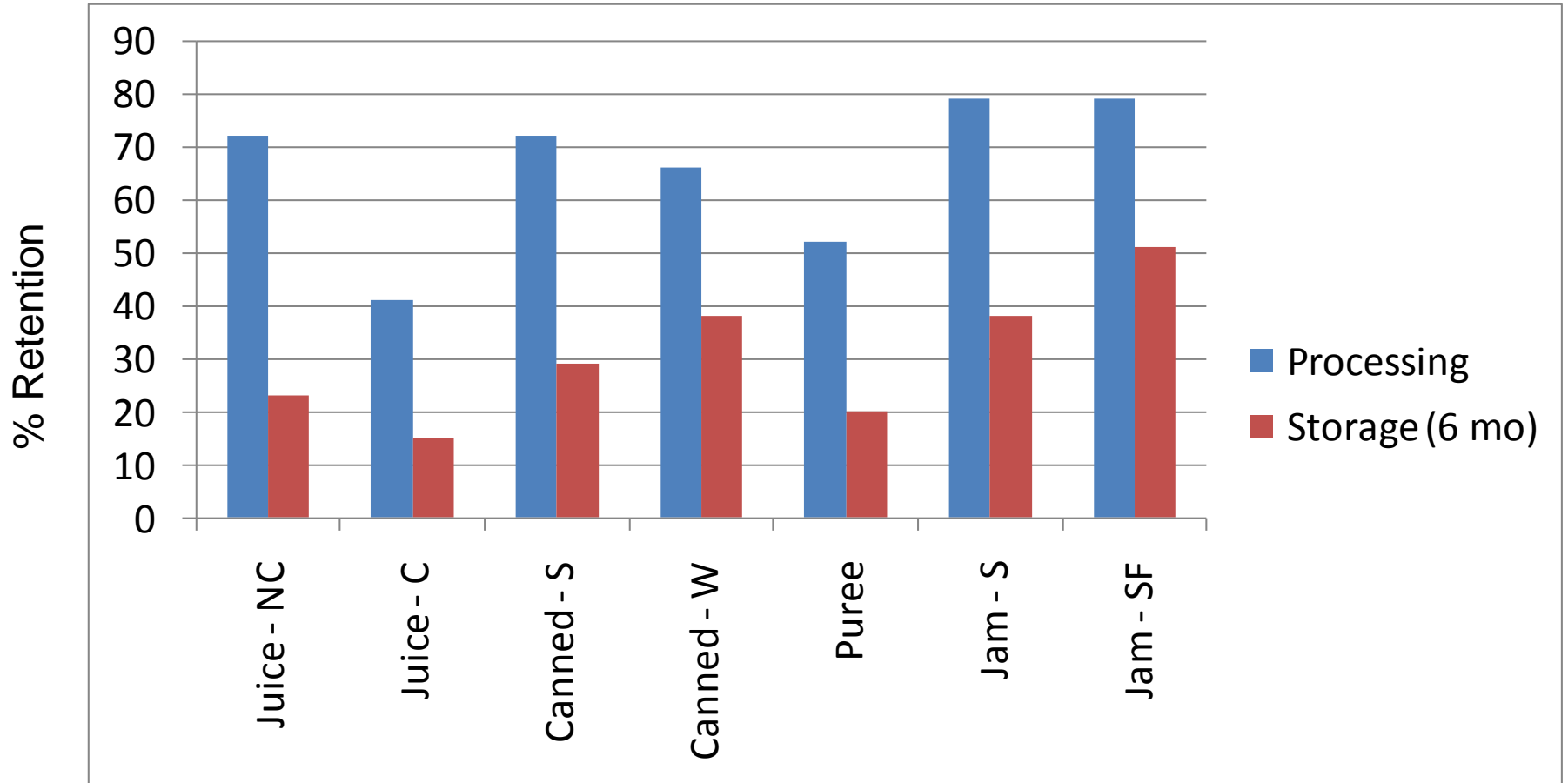
Objectives

- To determine how processing and storage influence the retention of berry polyphenols
- To identify methods to prevent polyphenol losses during processing and storage
- To discuss potential implications of processing on bioactive properties of berry polyphenols

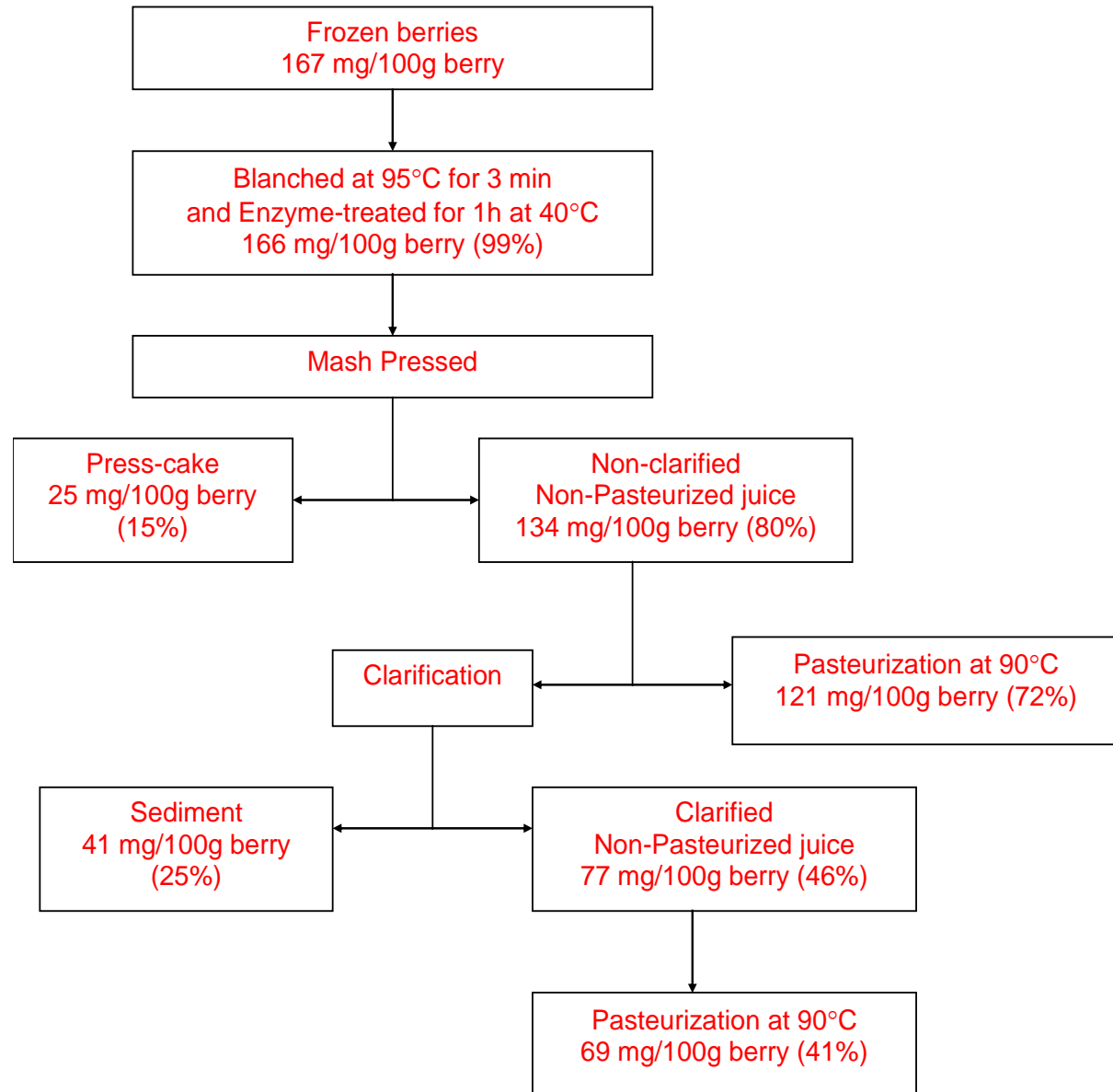


Processing & Storage Results

Blueberry Anthocyanin Retention in Response to Processing and Storage

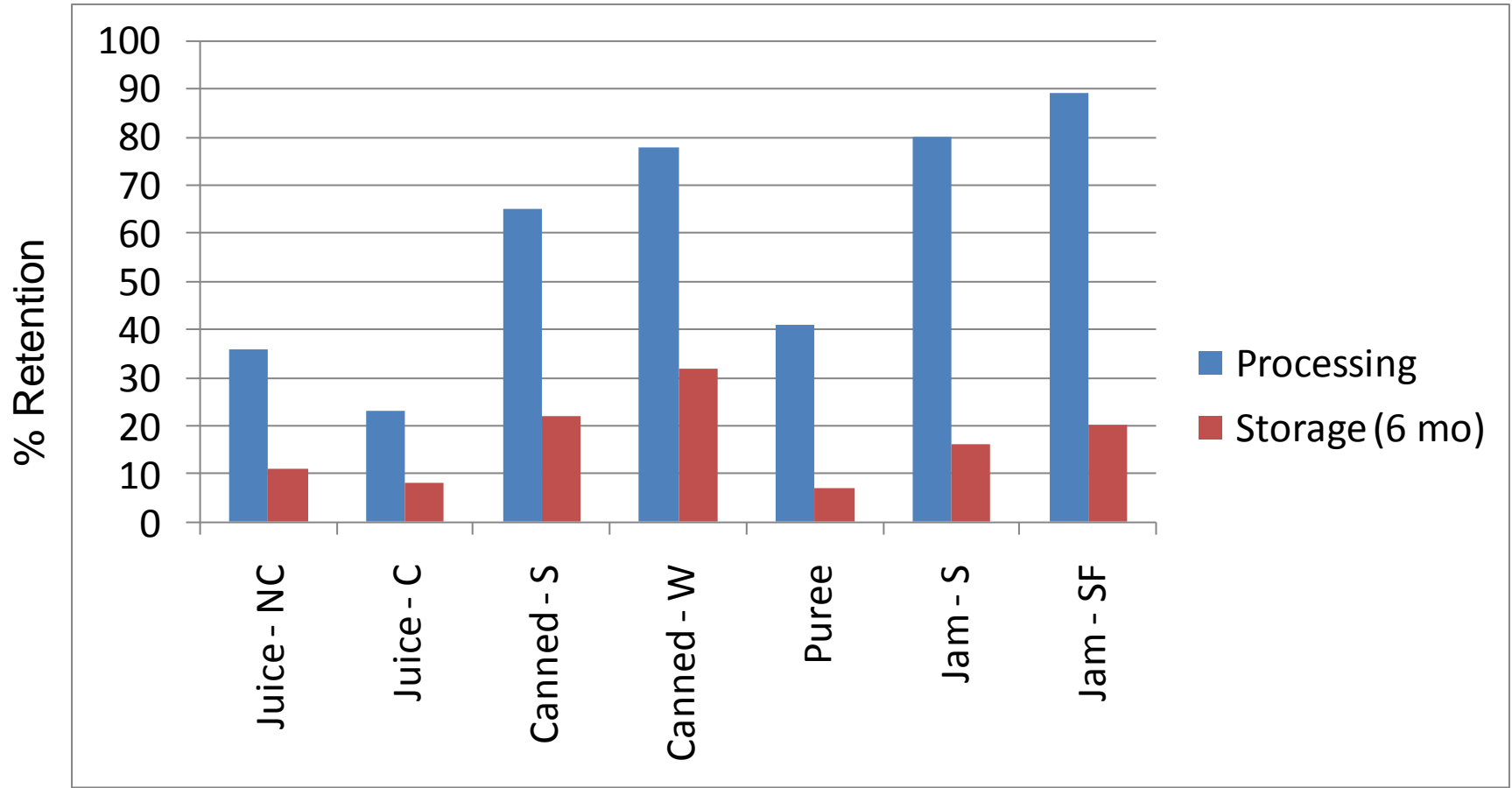


Anthocyanin Losses During Blueberry Juice Processing

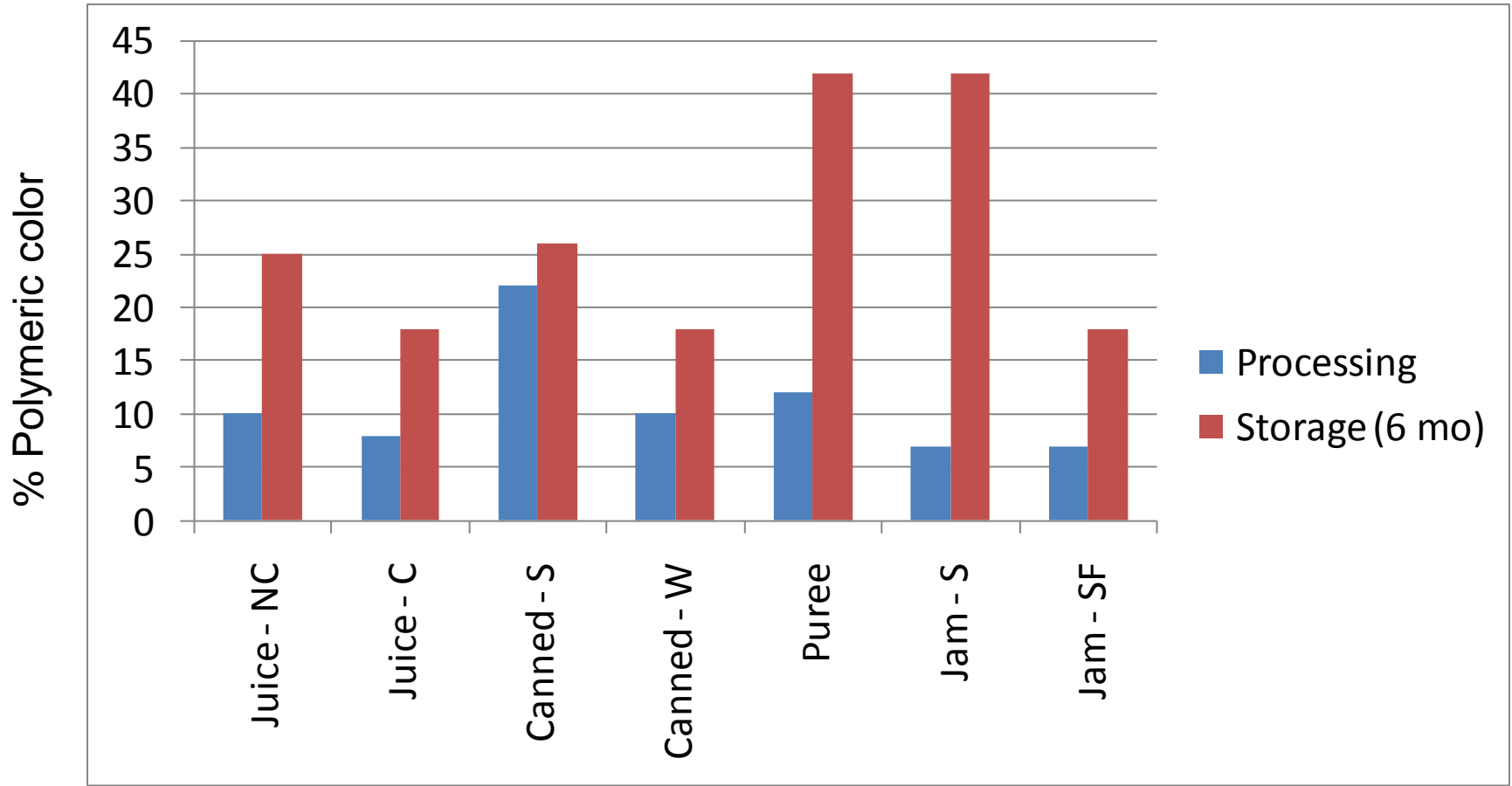


Waste materials are an excellent source of polyphenols

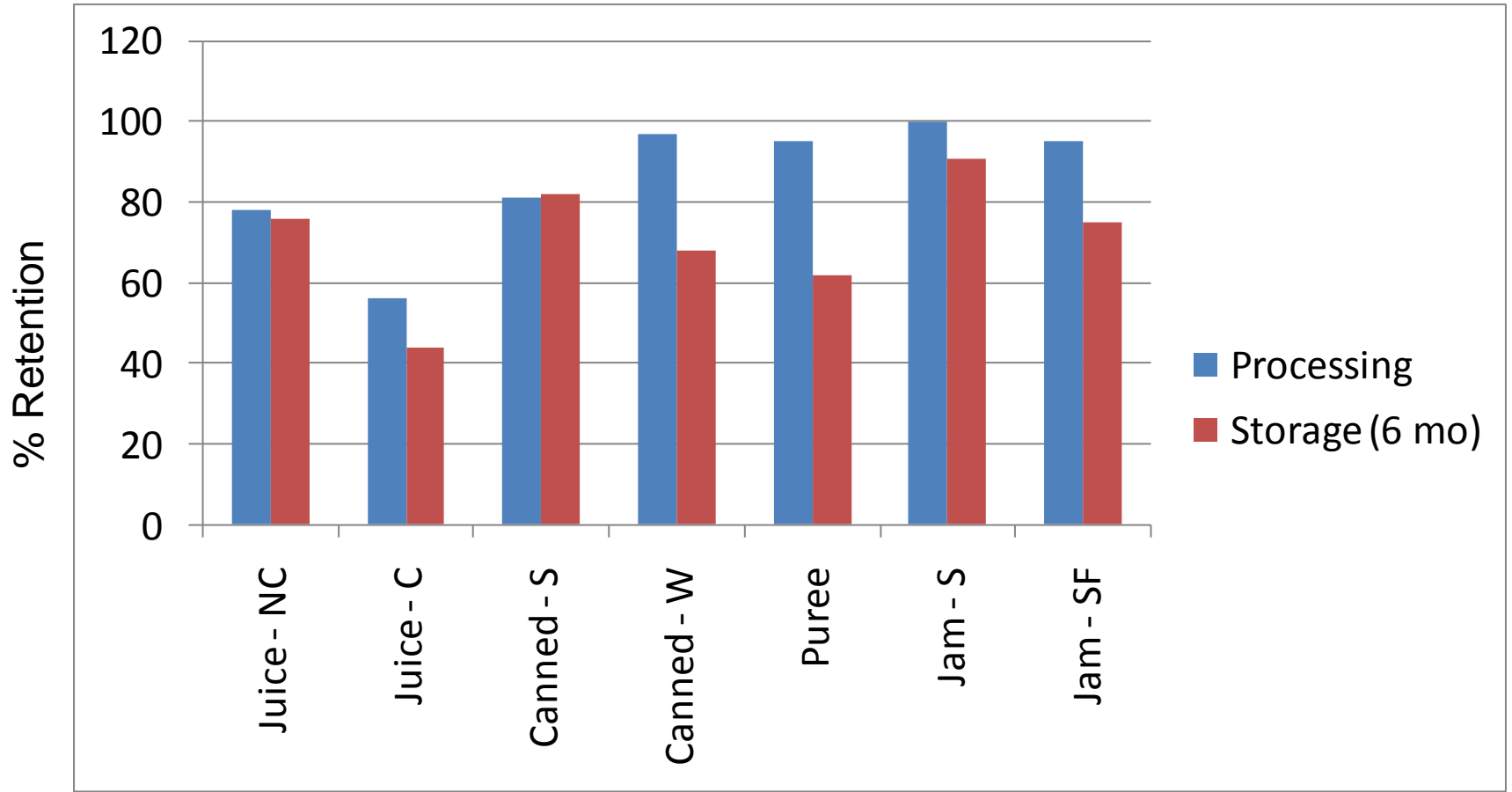
Blueberry Procyanidin Retention in Response to Processing and Storage



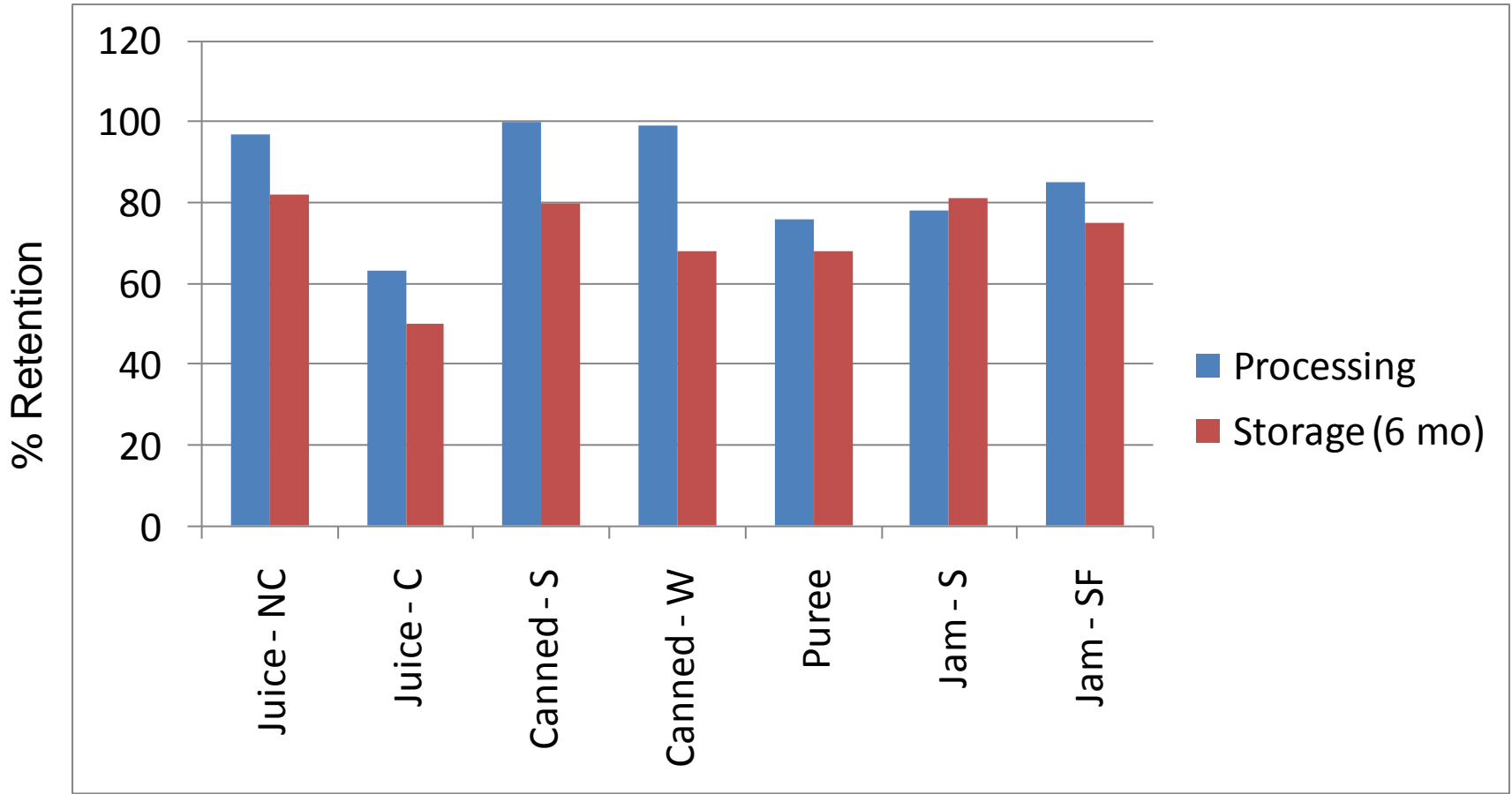
Blueberry Polymeric Color in Response to Processing and Storage



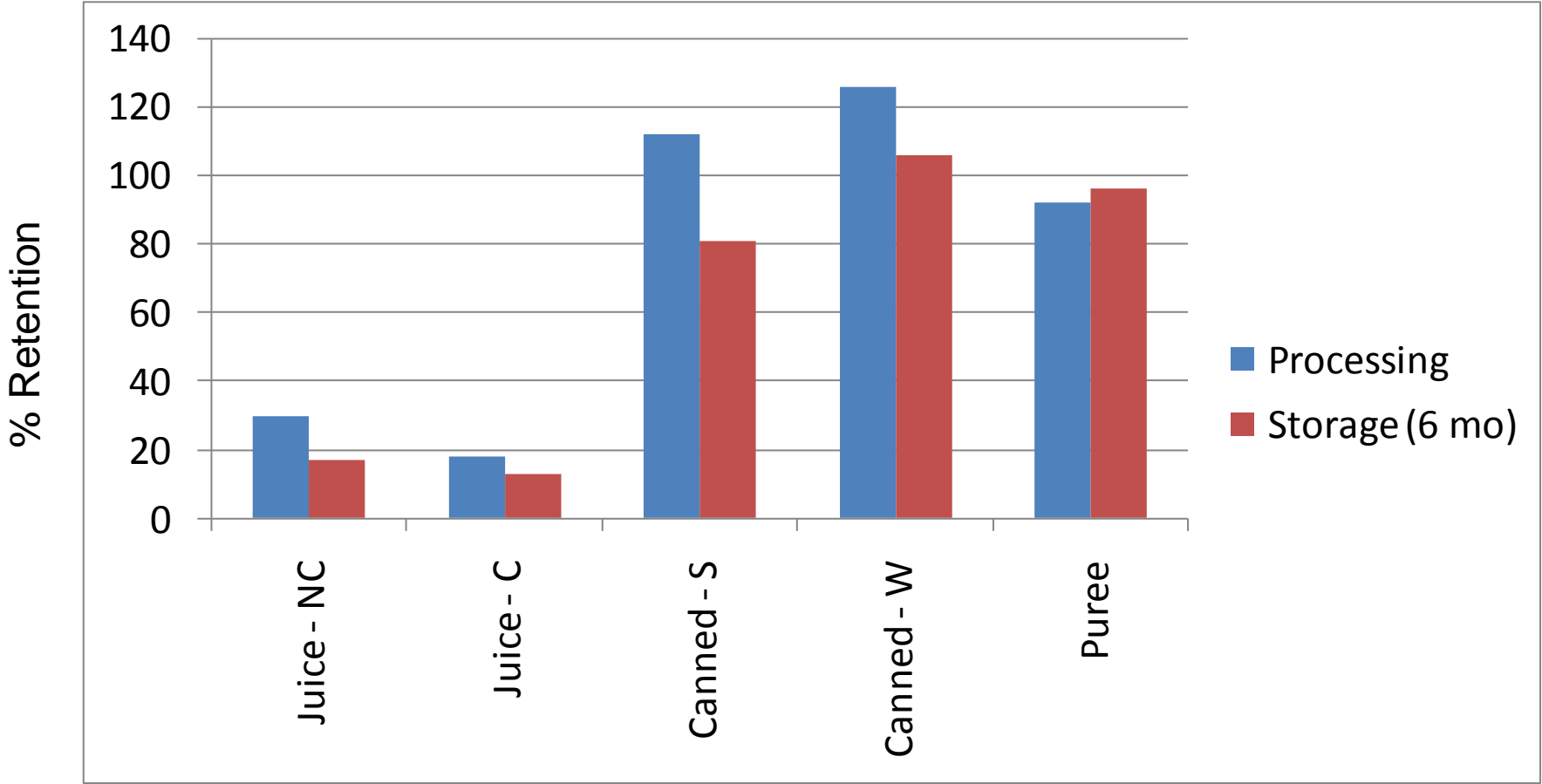
Blueberry Total Flavonol Retention in Response to Processing and Storage



Blueberry Chlorogenic Acid Retention in Response to Processing and Storage



Blackberry Total Ellagitannin Retention in Response to Processing and Storage

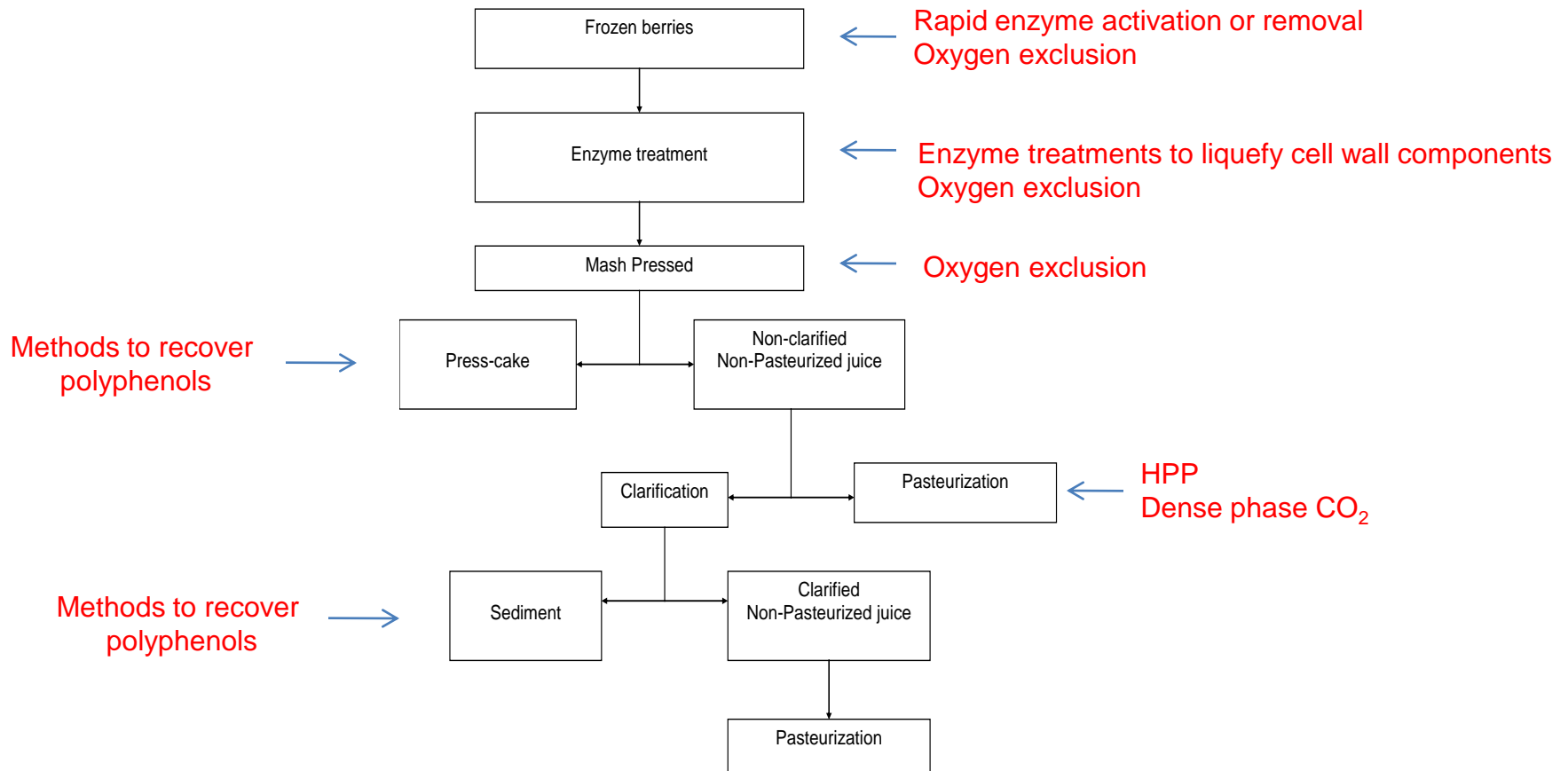


Processing Conclusions

- Exclusion of seeds and skins results in significant losses of polyphenols
- Waste materials are an excellent source of polyphenols
- Chlorogenic acid and flavonols are retained much better than anthocyanins, procyanidins & ET's
- In canned products, 30-50% of polyphenols diffused out of the berries into the liquid canning media
- Methods are needed to prevent polyphenolic losses during processing



Steps to Mitigate Polyphenol Losses During Juice Processing



“Green” Critical Fluid Options for Recovering Polyphenols from Waste Materials

CO₂
LCO₂

CO₂ & GRAS
(EtOH, H₂O)

Pressurized
H₂O

Non-polar

Polar

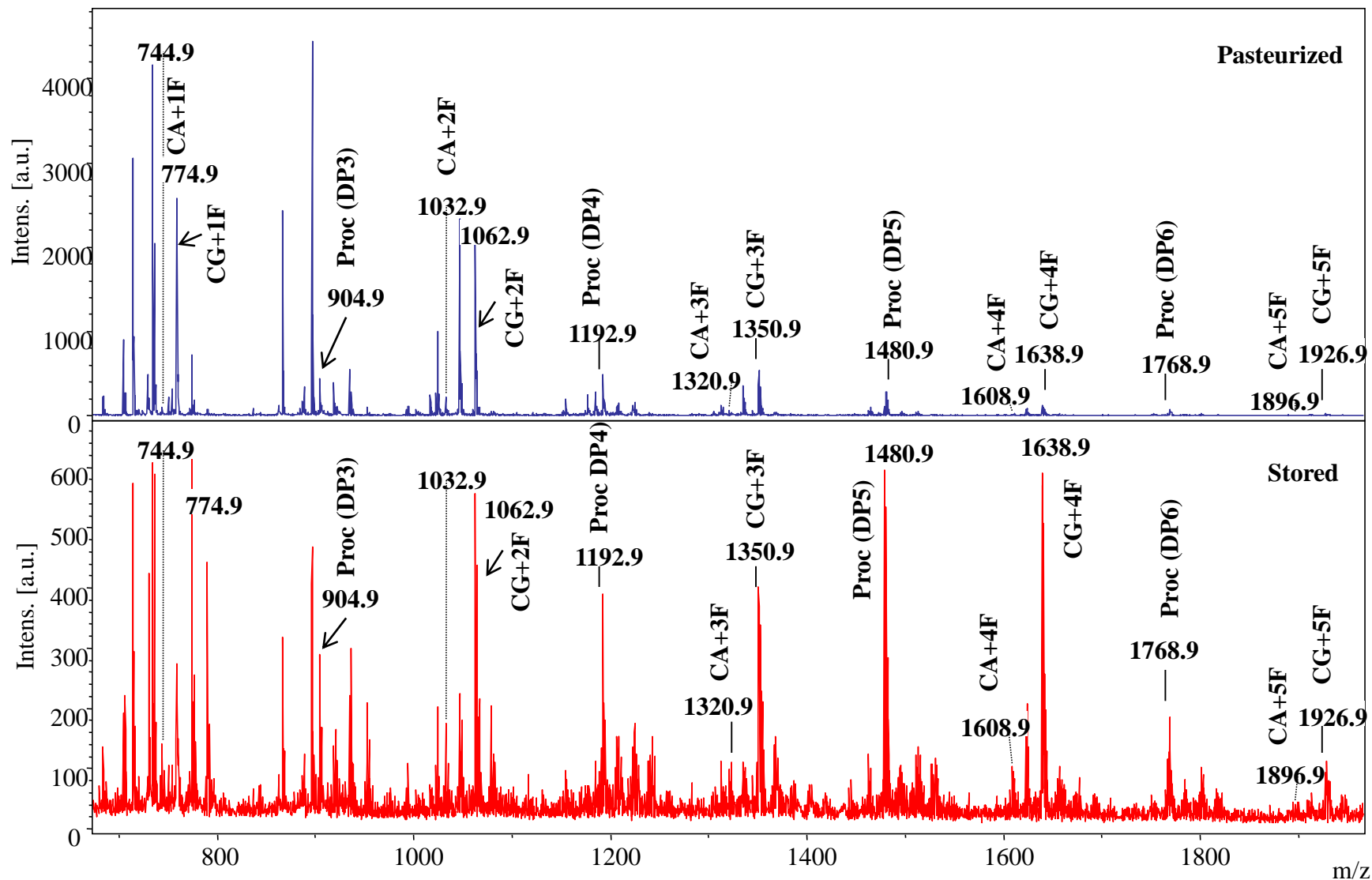


Solute Type

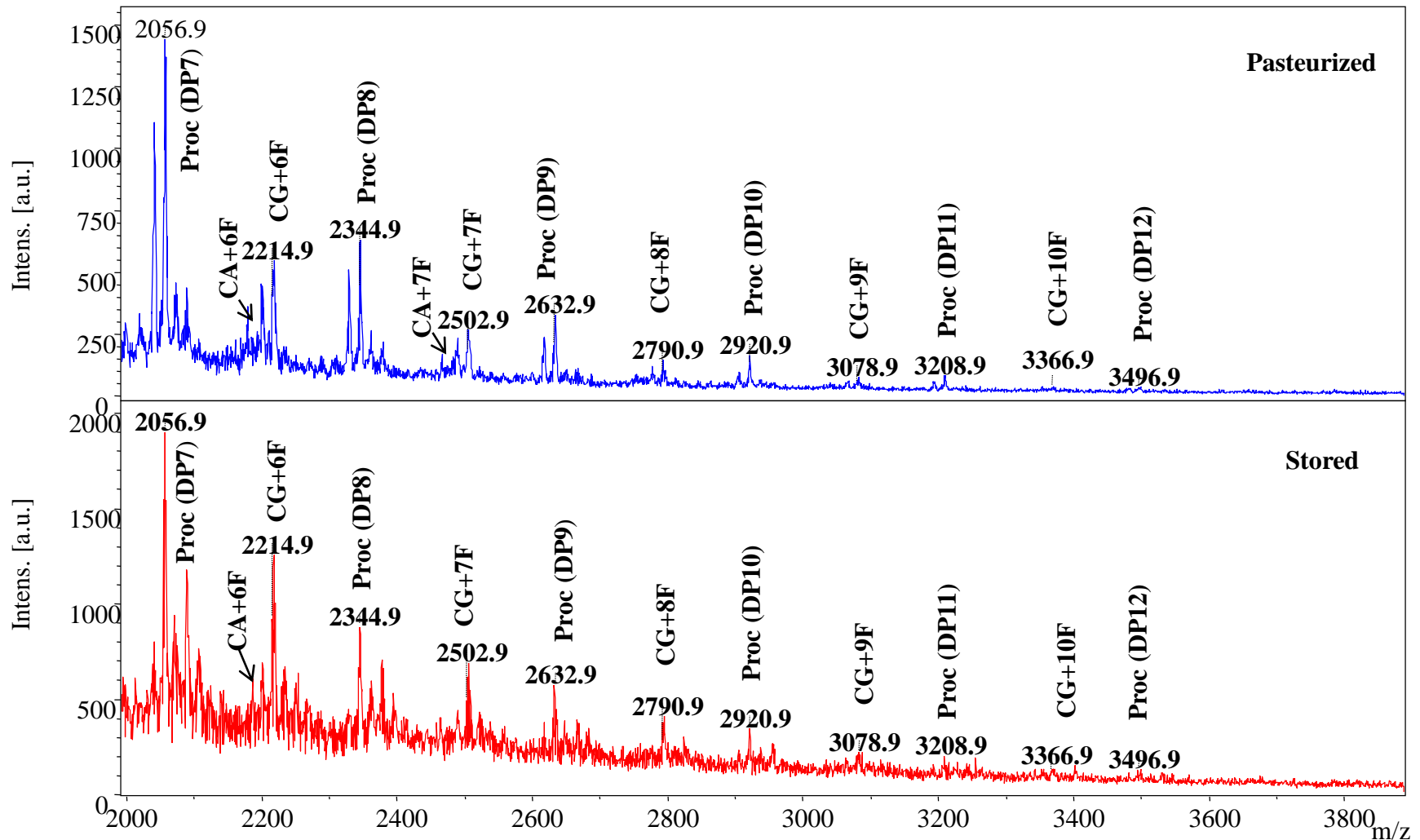
Storage Conclusions

- Monomeric anthocyanins and procyanidins were readily degraded and/or **polymerized** during storage
- Flavonols and chlorogenic acid were retained relatively well during storage
- Antioxidant capacity changed little during storage
- More research is needed to elucidate the structure, antioxidant capacity and bioavailability of polymeric pigments

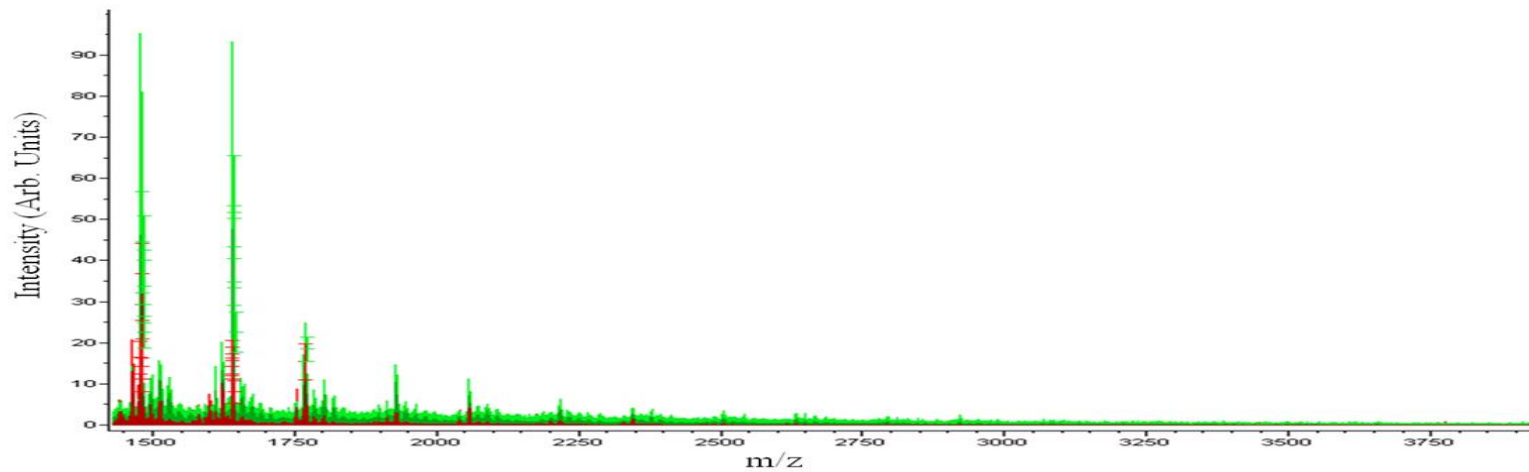
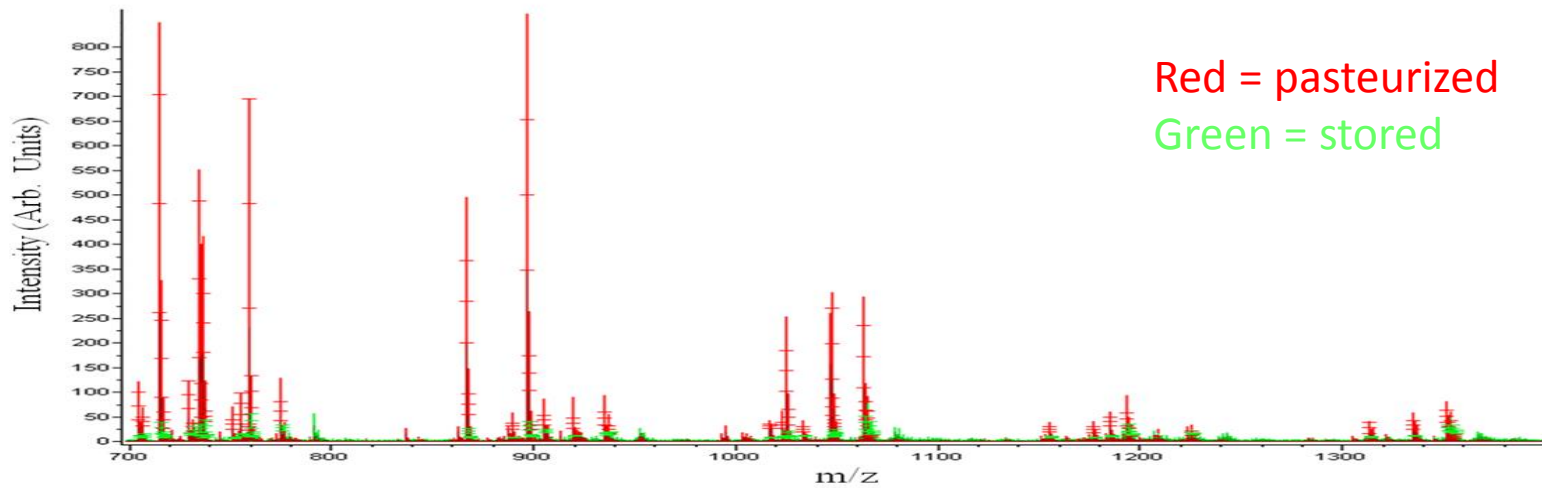
MALDI-TOF-MS Identification of Polymeric Pigments in Pasteurized and Stored Chokeberry Juice



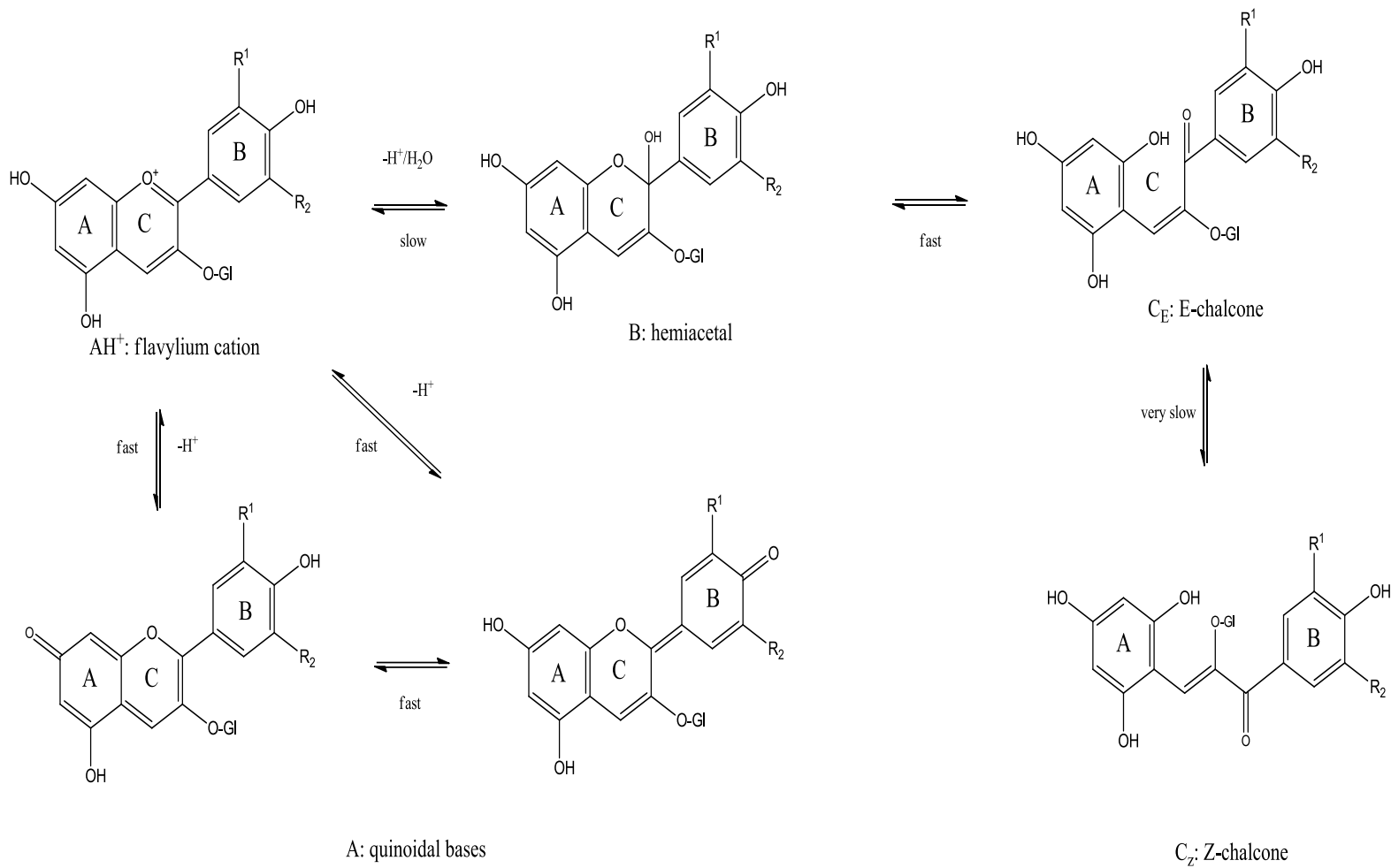
MALDI-TOF-MS Identification of Polymeric Pigments in Pasteurized and Stored Chokeberry Juice



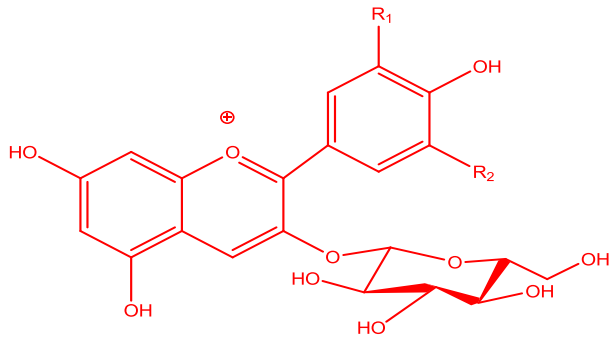
MALDI-TOF-MS Spectral Comparison of Pasteurized and Stored Chokeberry Juice



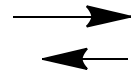
Methods to Stabilize Anthocyanins



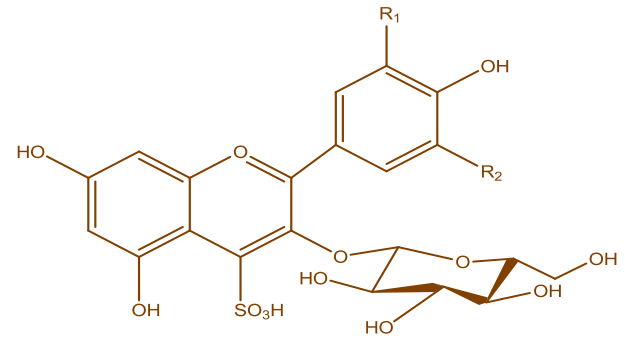
Polymeric Color



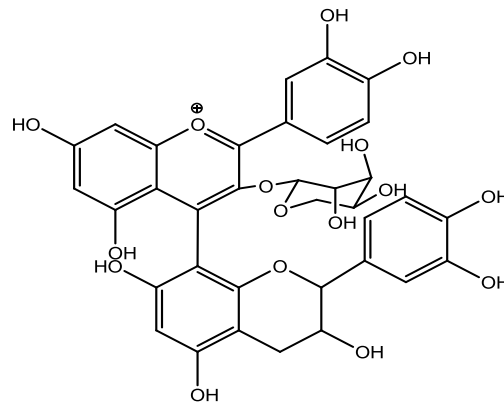
flavylium cation: red



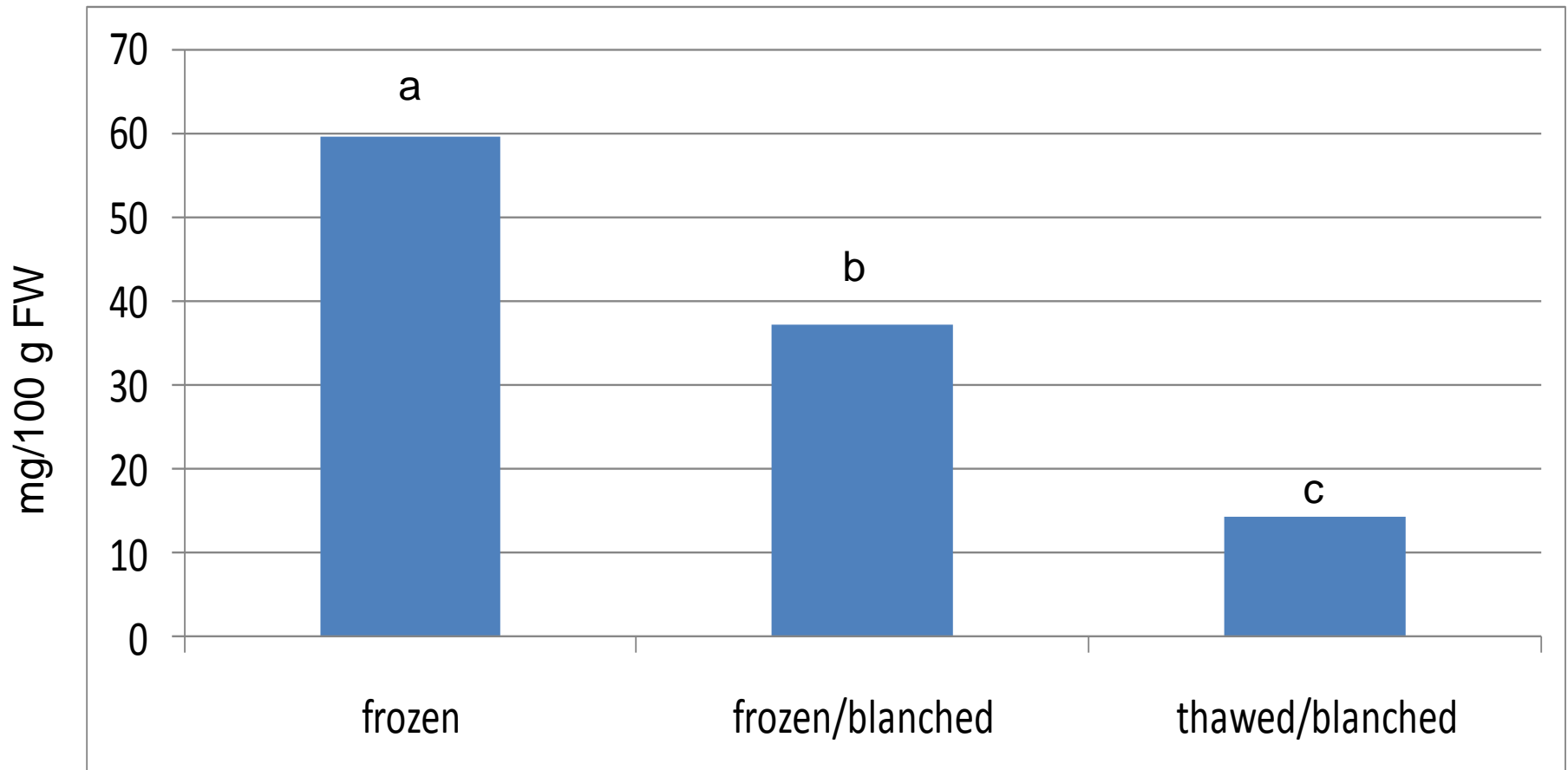
Strong acid



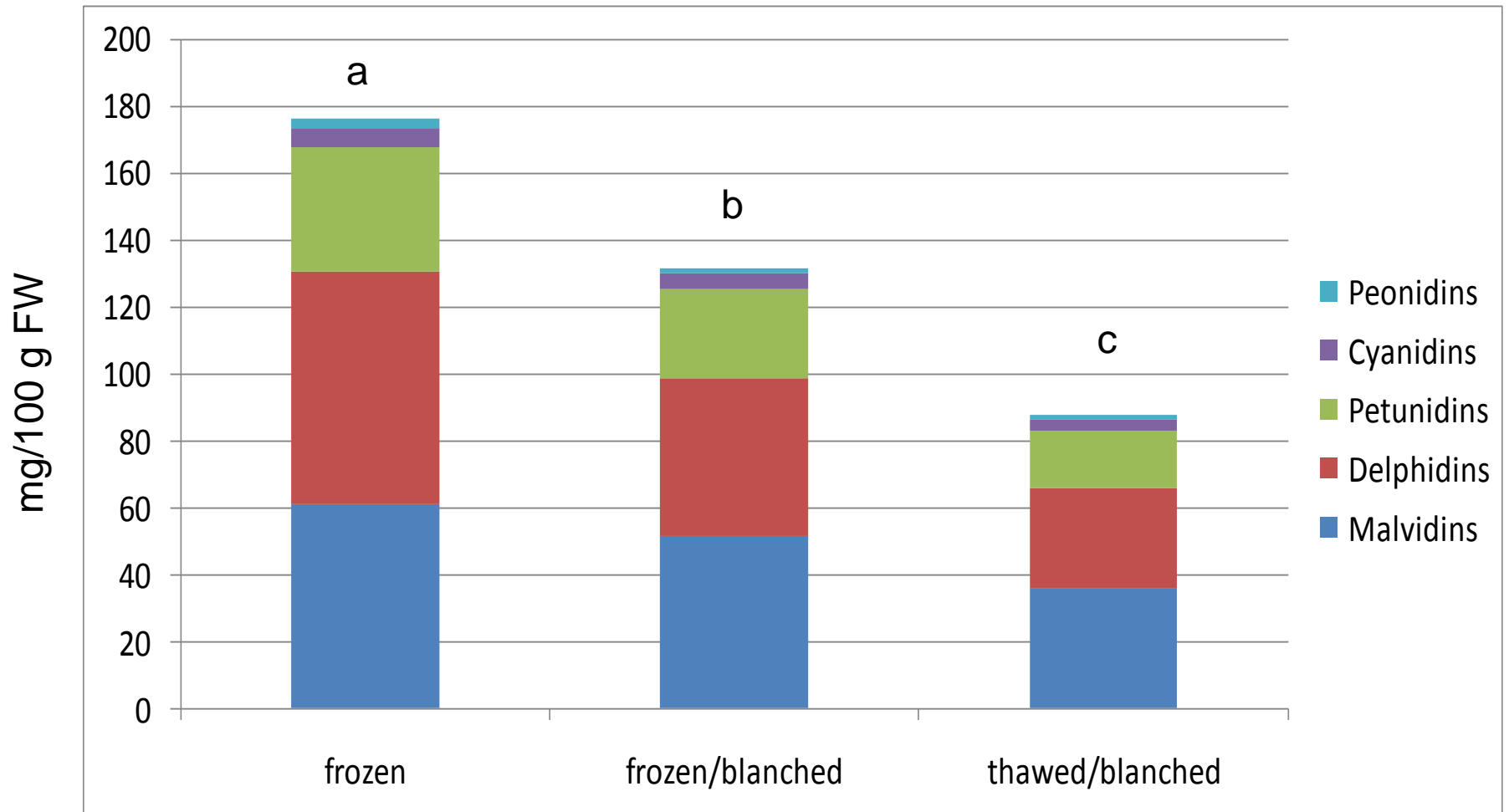
bisulfite addition compound: colorless



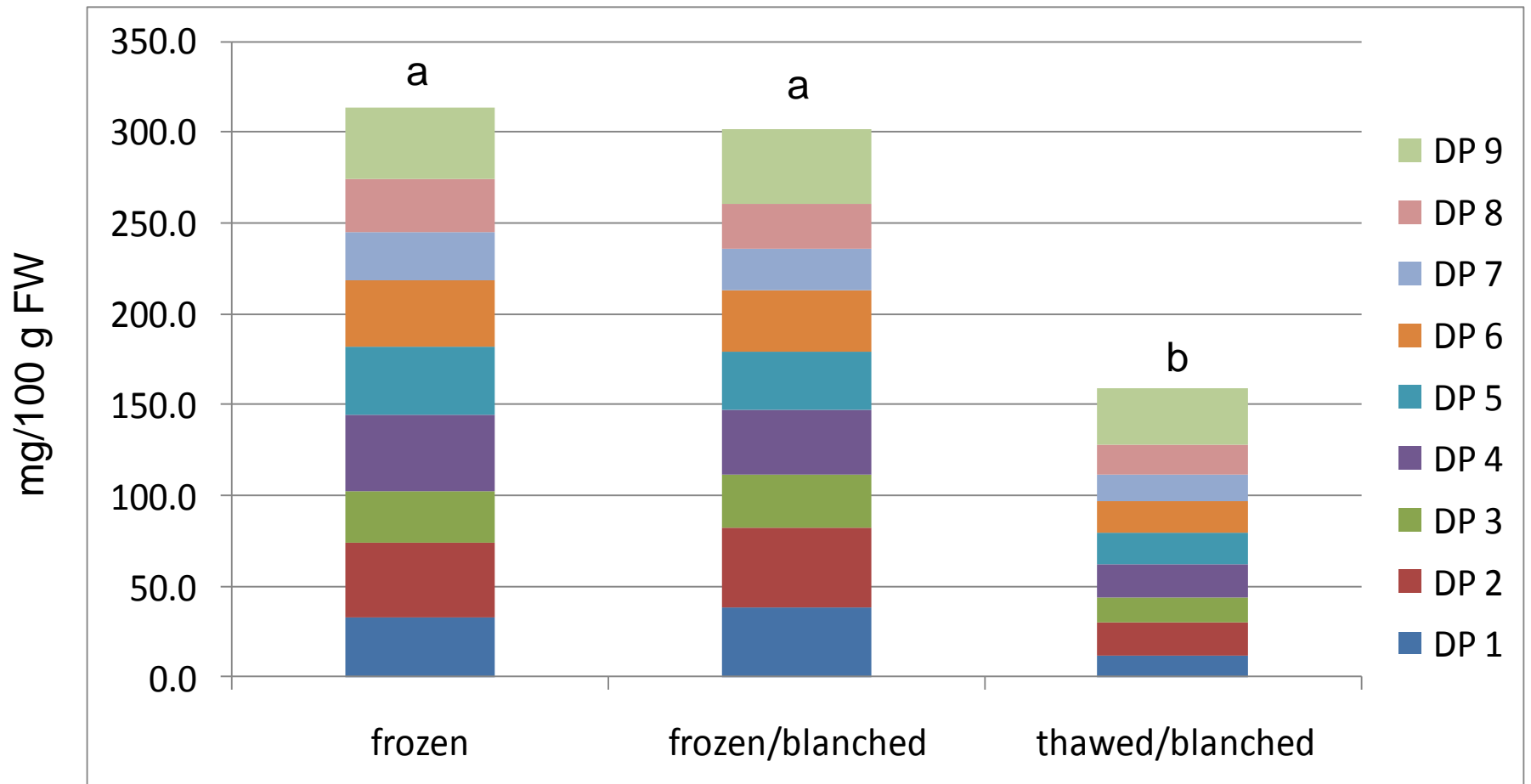
Effect of Thawing Blueberries Prior to Blanching on Chlorogenic Acid



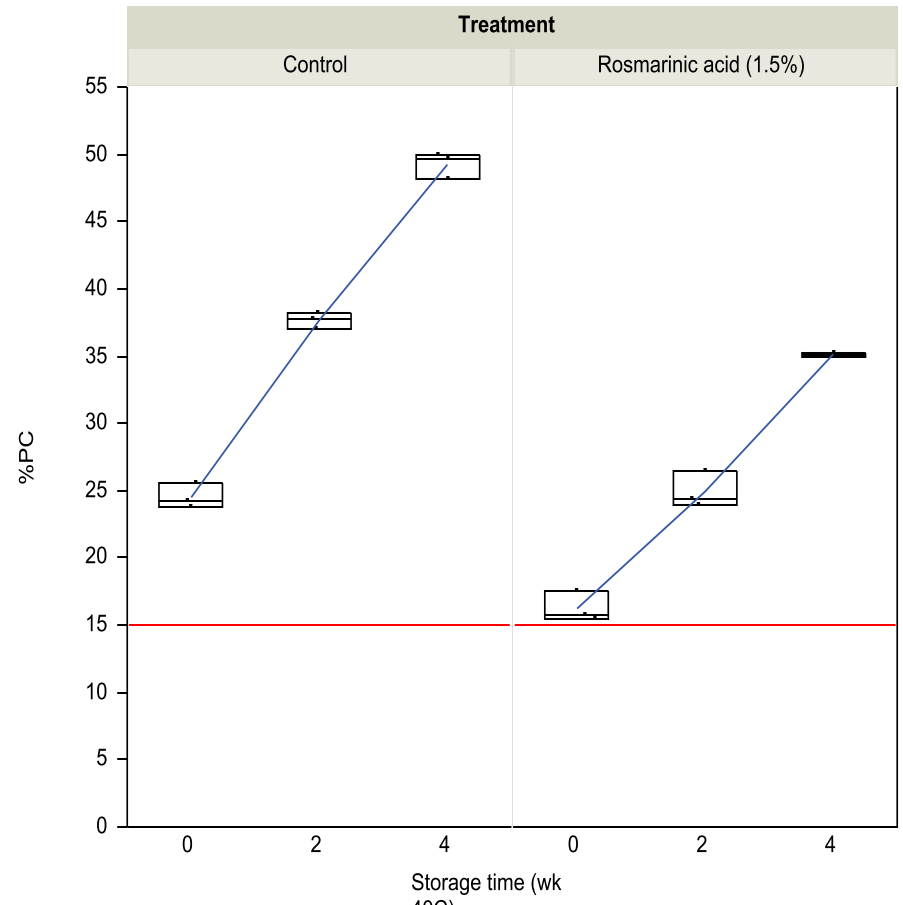
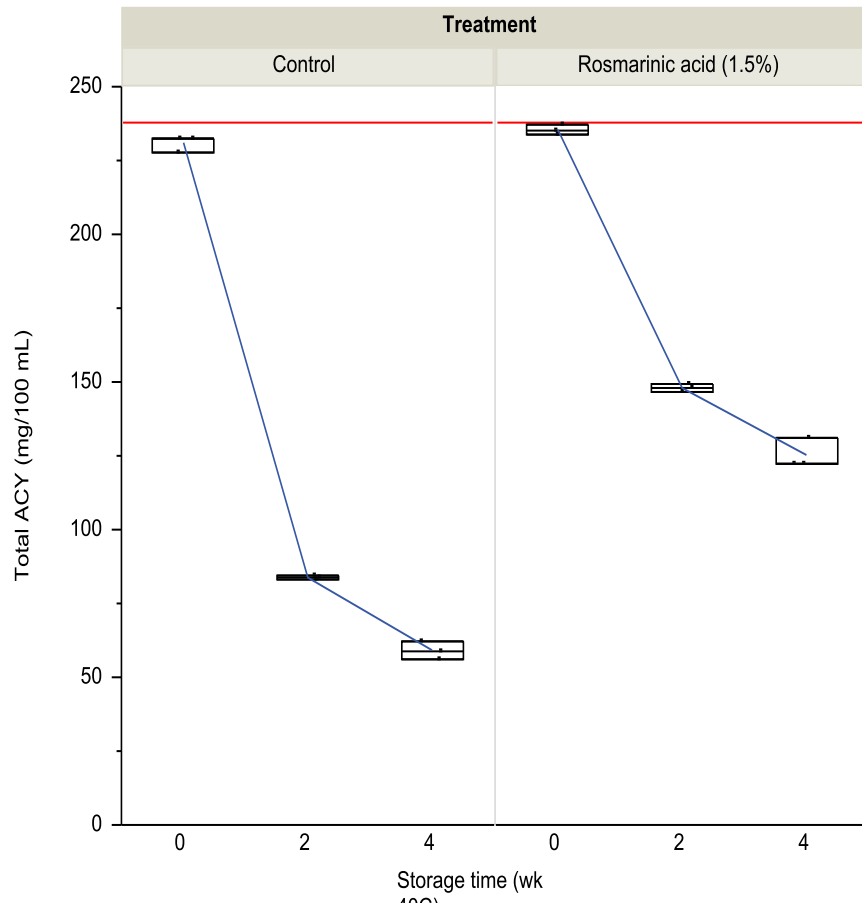
Effect of Thawing Blueberries Prior to Blanching on Anthocyanins



Effect of Thawing Blueberries Prior to Blanching on Procyanidins

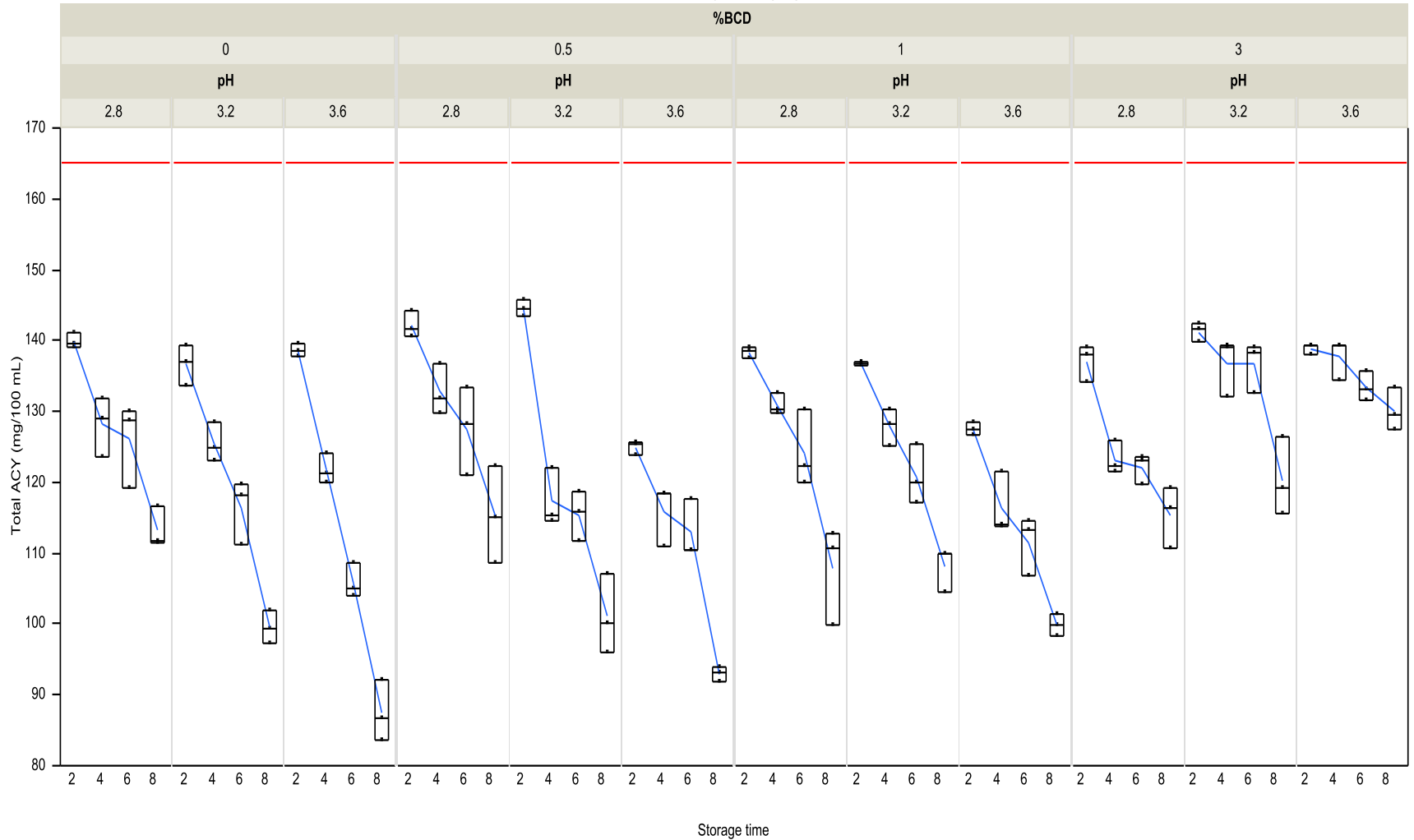


Effect of Rosmarinic Acid Fortification of Blueberry Juice on Total ACY and %PC



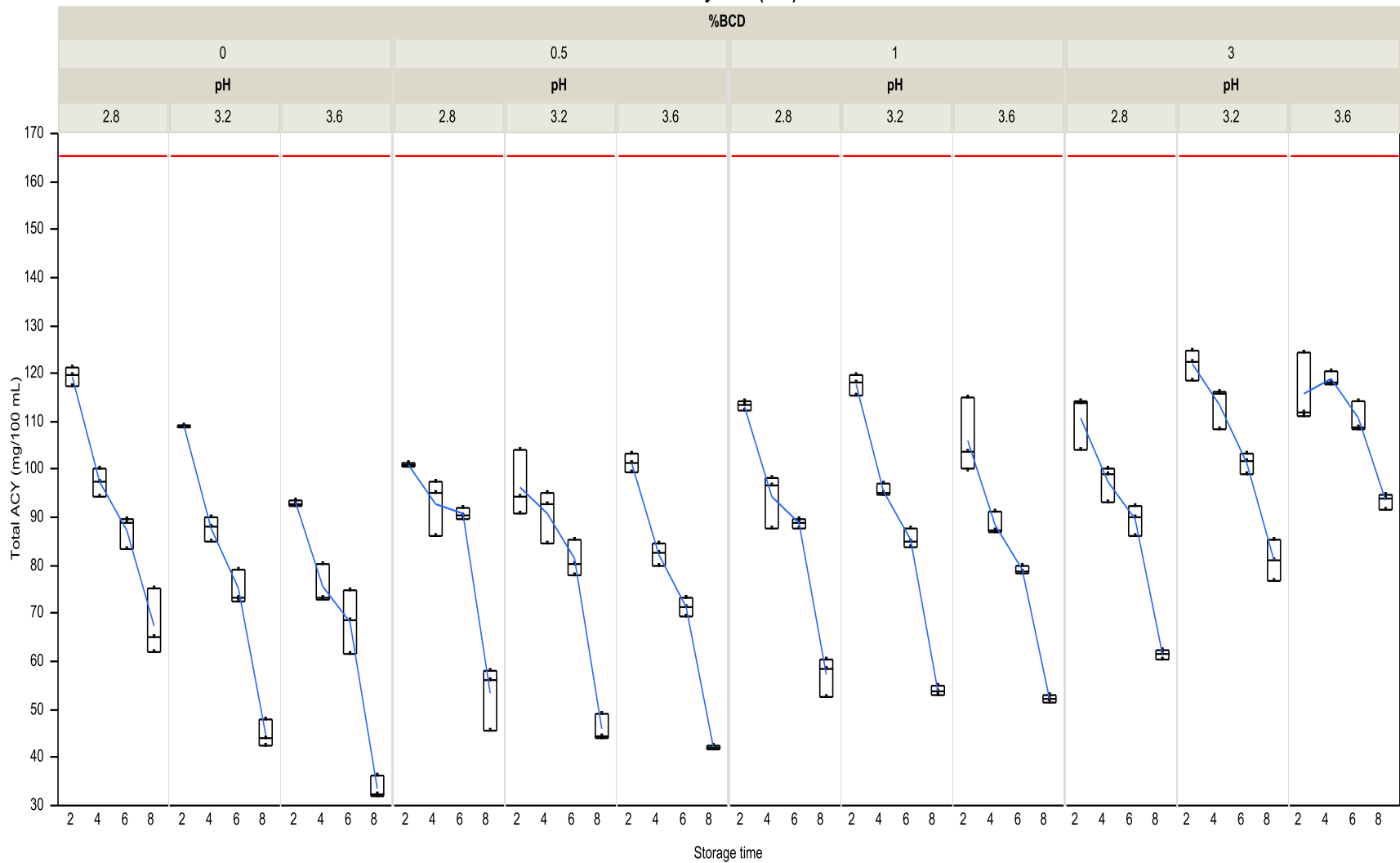
Effects of pH Adjustment and BCD Treatment on Stability of Chokeberry Juice Anthocyanins (4°C)

Total Anthocyanins (4C)

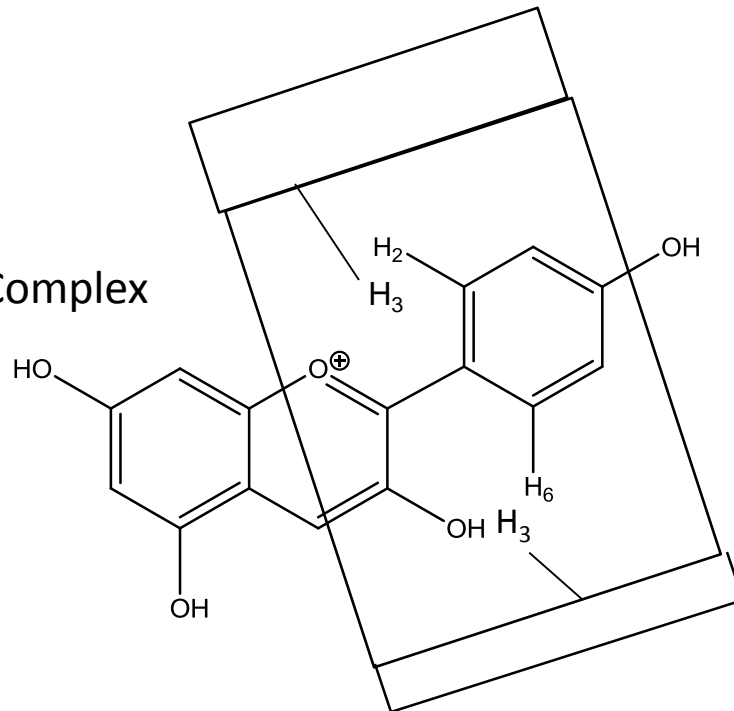


Effects of pH Adjustment and BCD Treatment on Stability of Chokeberry Juice Anthocyanins (25°C)

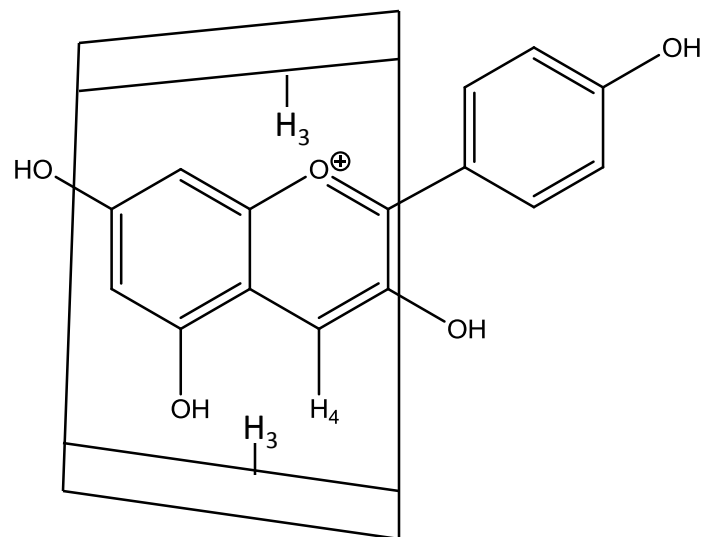
Total Anthocyanins (25C)



β -CD-PG Complex

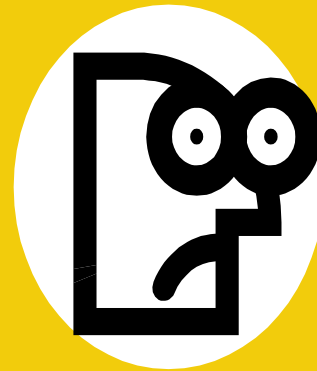
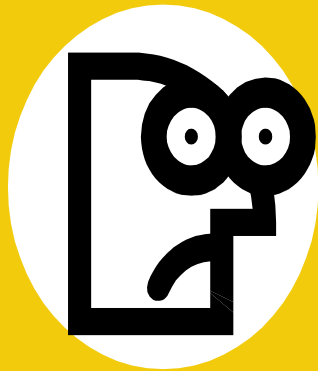


γ -CD-PG Complex



Conclusions

- Rapid enzyme inactivation results in greater retention of polyphenols
- Encapsulation and co-pigment treatments protect anthocyanins during storage
- **Berry products should be refrigerated!**



It's QUESTION TIME !!