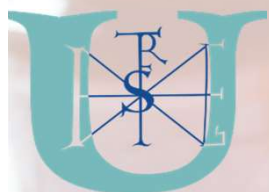International Symposium on Bee Products
5th edition Sliema, Malta, 2019

DETECTION OF HEAT TREATMENT OF HONEY BY RAPID CORRELATIVE TECHNIQUES

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Juicy material

Sap of Plant parts
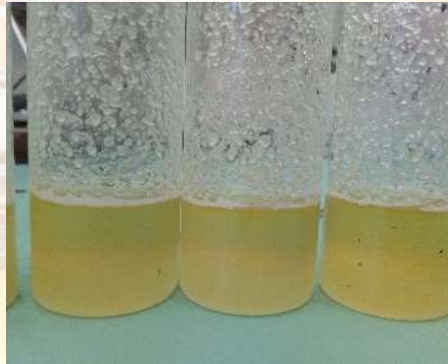
Nectar
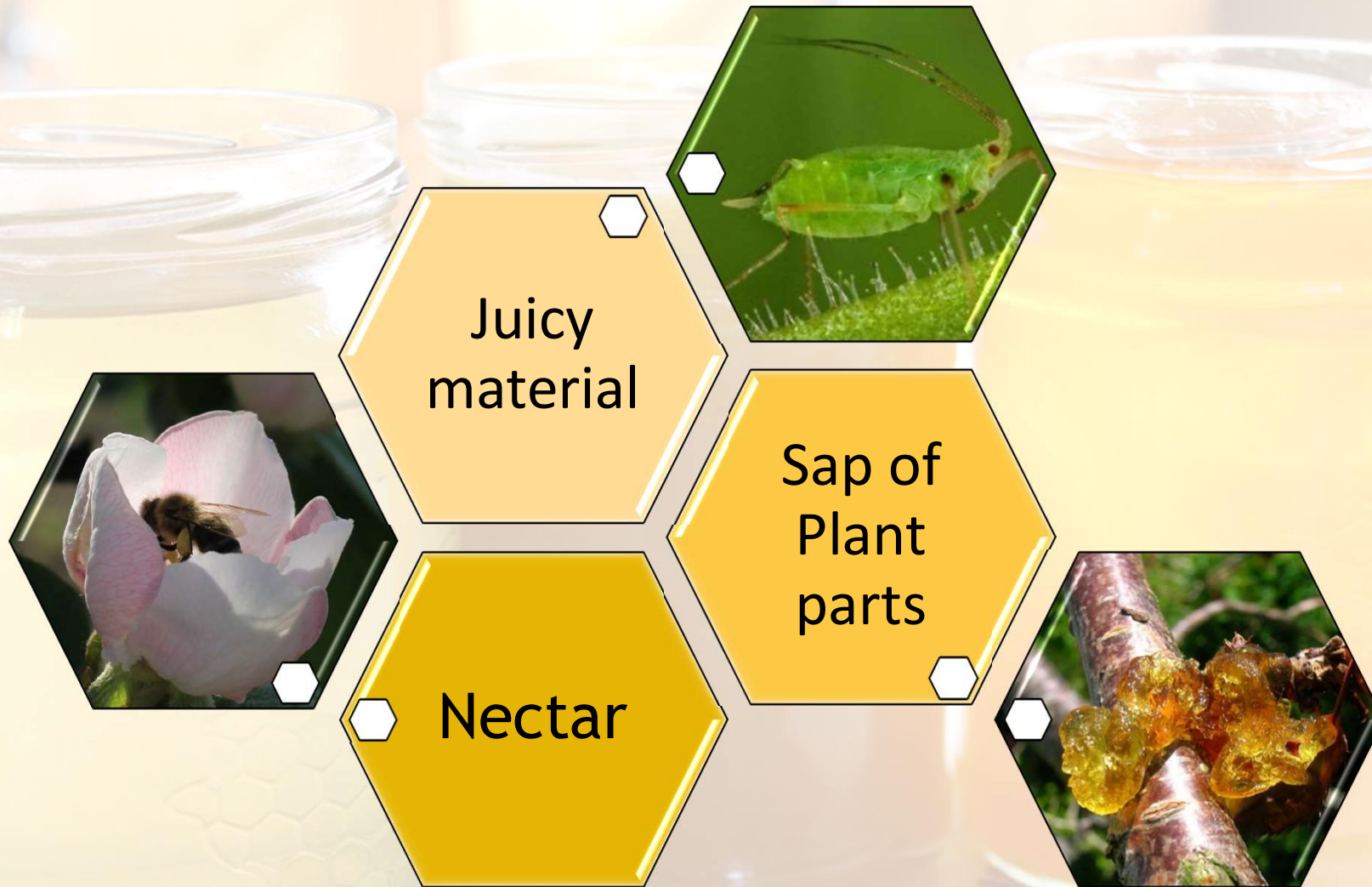
ACTUALITY

Importance of botanical and geographical origin

Adulteration

- Direct (adding syrups)
- Indirect (feeding bees with syrup)
- Others (heating, evaporation)

Heat treatment of honey

- The reason:
  - Crystal elimination, easrier handling
- Consequences→ changes in honey
  - Hydroxymethyl-furfural (HMF) (max. 40 mg/kg)
  - Enzymes, antioxidants
  - aroma, color

OUR AIMS

Monitoring the changes during heat treatment in honey in:

Parameters previously described in the literature	Not reported in the literature before for heat
• hydroxymethyl-furfural content (HMF), • Antioxidant properties	• Near infrared spectroscopy (NIR), • Electronic tongue (ET)

MATERIALS AND METHODS

HONEYS

Minimal heat treatment

- Honey types
  - **Acacia**
  - **Sunflower**
  - **Linden**
  - **Multiflora**
- 120 samples
  - Control (not heated)
  - 40°C, 50°C, 60°C
  - 30, 60, 120 minutes

Extended experiment

- Honey types
  - **Sunflower**
- 15 samples
  - Control (not heated)
  - 40°C, 60°C, 80°C, 100 °C
  - 120 minutes

7

PHYSICO-CHEMICAL METHODS – QUALITY INDICATORS

Total soluble dry matter content

- Abbé-type refractometer

pH

- Testo 205 portable pH meter

Electrical conductivity

- Mettler Toledo

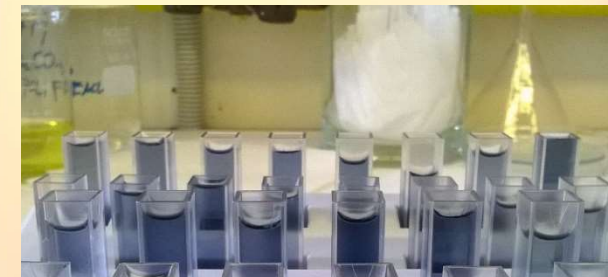# PHYSICO-CHEMICAL - UV/VIS SPECTROPHOTOMETRY

Helios α spectrophotometer

Hydrodymethyl-
furfural (Winkler
method)

550 nm

ABTS antioxidant
capacity

734 nm

Total polyphenol
content
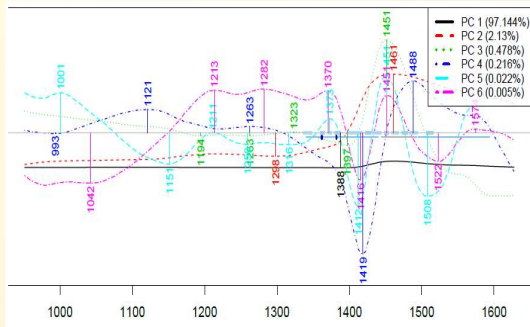750 nm

Rapid methods

αAstree Electronic tongue

Potentiometric (Ag/AgCl,

7 CHEMFET electrode)

Based on human sensory organs

- 10 g honey -> 100 ml (distilled water)

Near infrared spectroscopy (NIRs)

- 900-1700 nm
- 0.4 mm layer thickness of cuvette
- ~ 2 g honey

STATISTICS

Univariate for the physico-chemical methods

- Descriptive statistics
- ANOVA – Variance analysis followed by pairwise comparison

Multivariable for rapid methods

- Data pre-treatments
  - ET (drift correction, outlier detection)
  - NIR (smoothing, baseline shift correction, outlier detection)
- Principal componens analysis (PCA)
- Linear discriminant analysis (LDA) - Three-fold cross validation

Softwares

- MS Excel 2016
- R-studio 3.4.1

RESULTS

Means and SD of HMF content of Linden honeys by heat treatment level (n=90)

Bodor et al. / AWETH Vol 13.2. (2017)
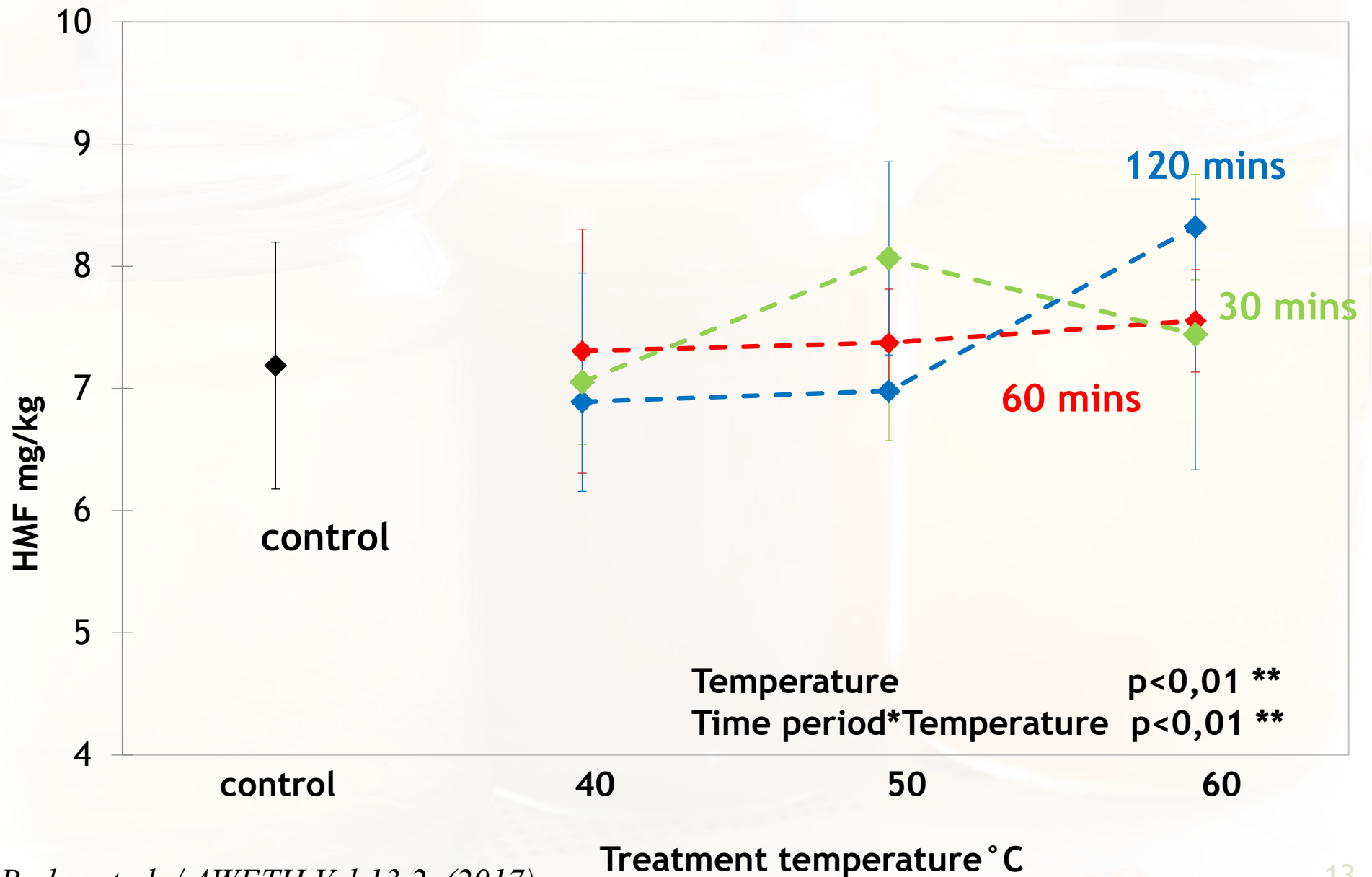
Means and SD of ABTS antioxidant capacity of linden honeys by heat treatment level (n=90)

Bodor et al. / AWETH Vol 13.2. (2017)
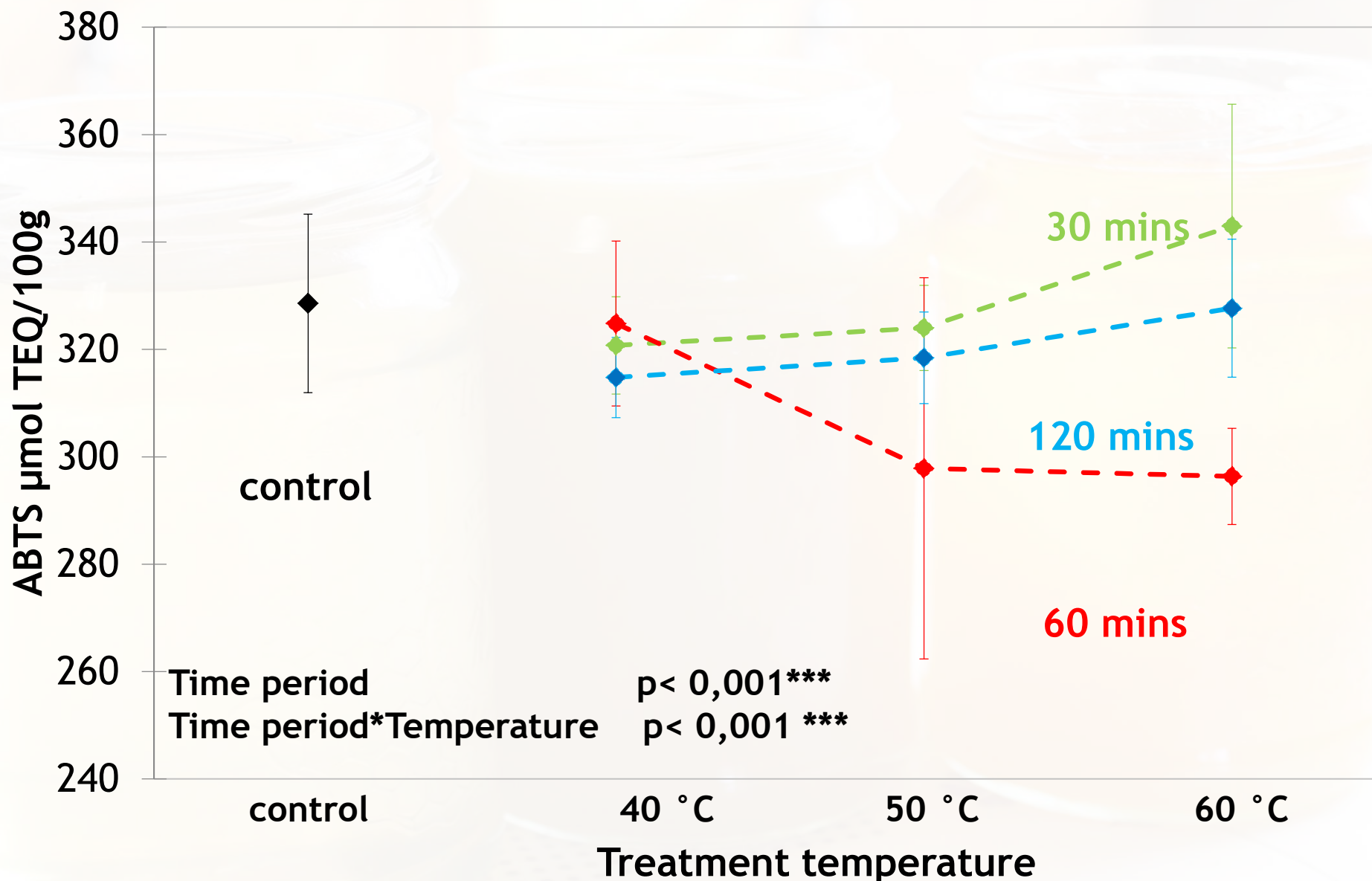
PCA results of NIR spectra of linden honeys after Saviztky-Golay smoothing, MSC and outlier detection by temperature groups (n=80)

control

PC 2 (2.188%)

0.03

0.02

0.01

0.00

-0.01

-0.02

-0.03

40 °C

50 °C

60 °C

-0.1

0.0

0.1

PC 1 (96.363%)

LDA for temperature levels	
Model building	92.13%
Model validation	83.06%
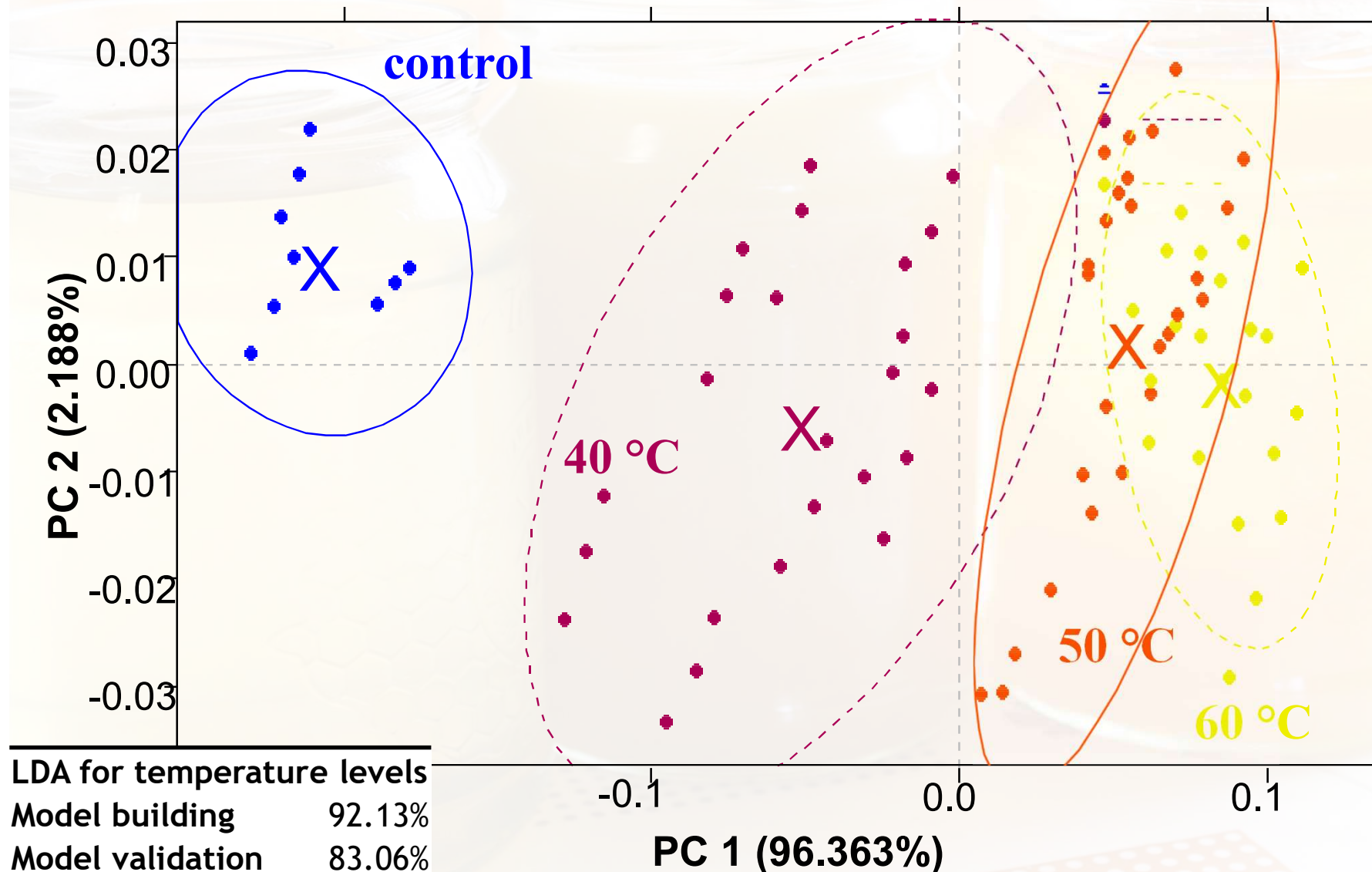
PCA results of NIR spectra of acacia honeys after Saviztky-Golay smoothing, MSC and outlier detection by temperature groups (n=78)
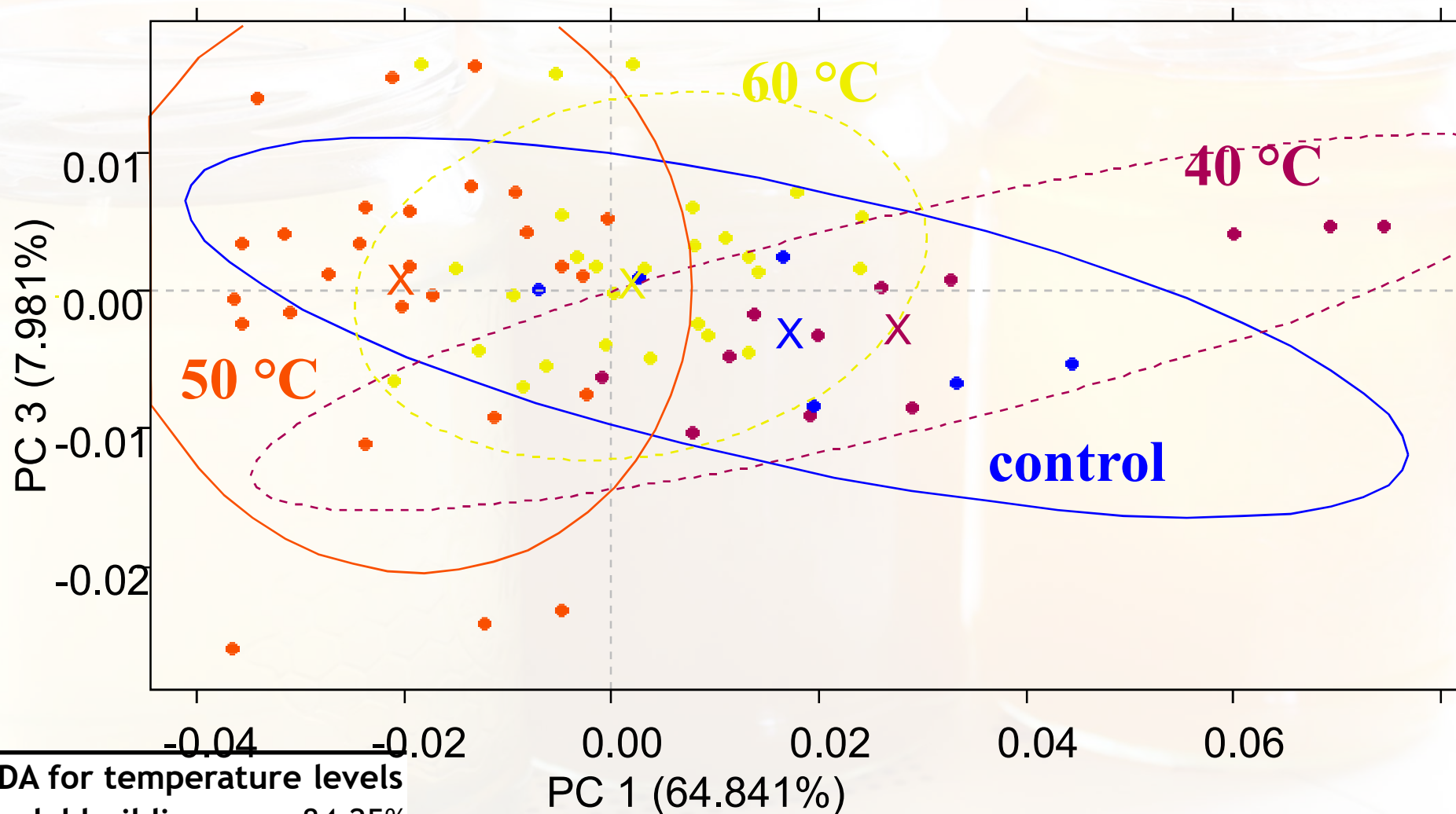
LDA for temperature levels

Model building	84.25%
Model validation	59.99%

LDA results of electronic tongue data of multiflora honeys by temperature levels (n=110)

LDA for temperature levels
Model building   85.45%
Model validation 71.10%

root2 - 14.21%

root1 - 83.63%

Legend: cont, 40C, 50C, 60C

LDA results of electronic tongue data of acacia honeys by temperature levels (n=111)
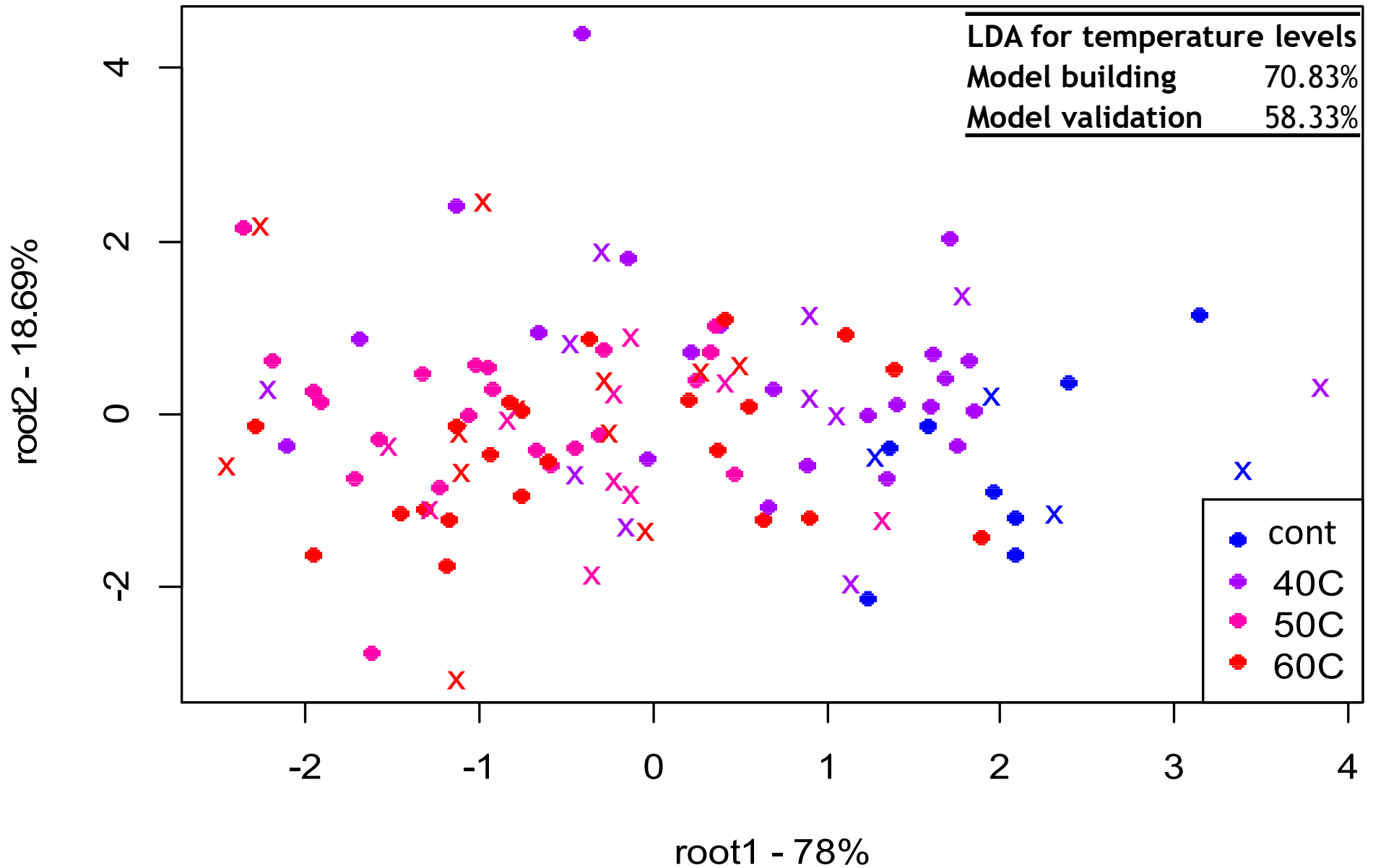
Extended expereiment

HMF CONTENT OF HEATED SUNFLOWER HONEYS AT DIFFERENT TEMPERATURES FOR 120 MINUTES n=45
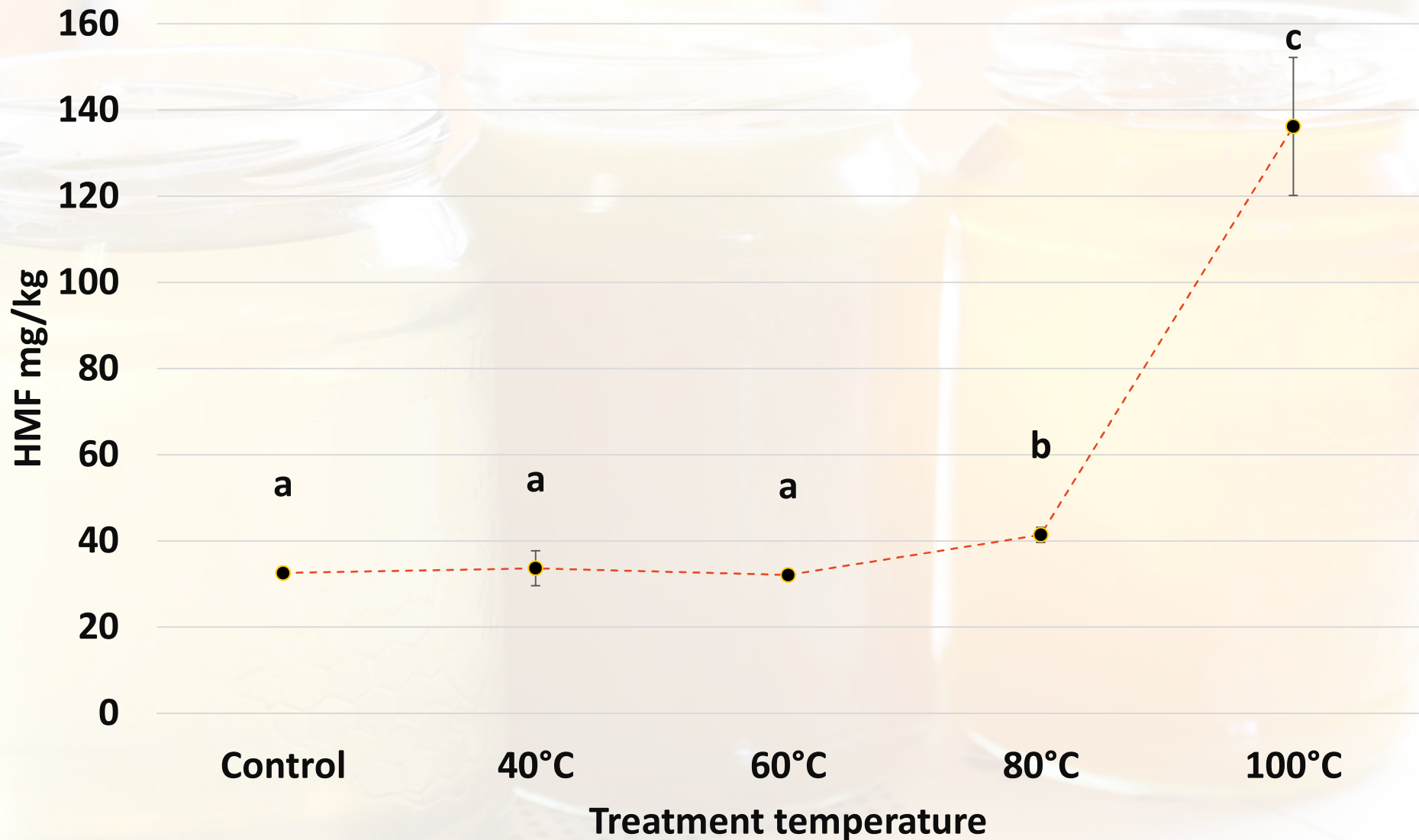
Letters mean the significant differences p<0.05

ABTS ANTIOXIDANT CAPACITY AND TPC CONTENT OF SUNFLOWER HONEY AT THE DIFFERENT HEATED LEVELS FOR 120 MINUTES (n=75)

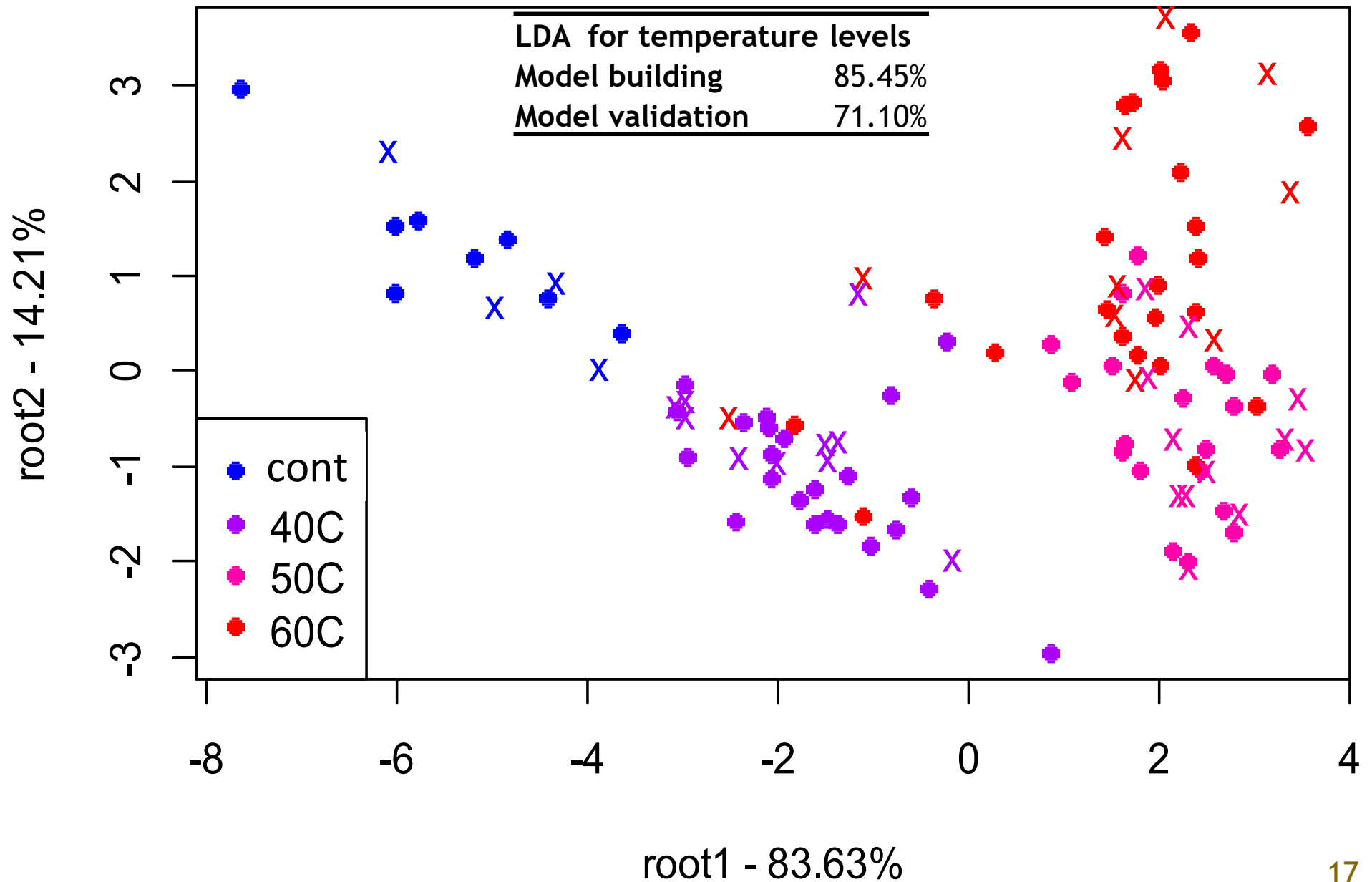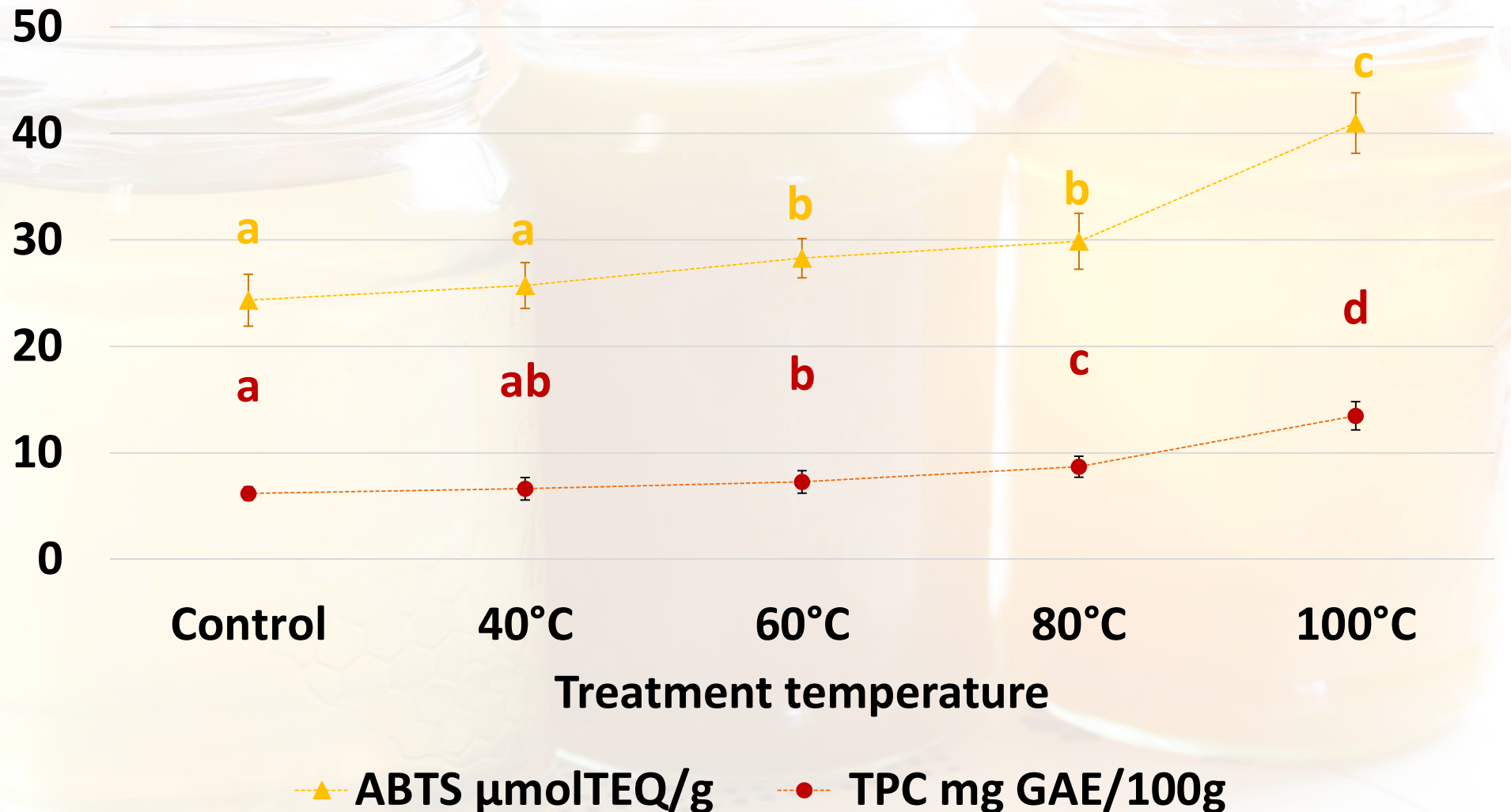Letters mean the significant differences $p < 0.05$

LDA results of NIR (METRI) spectra of sunflower honeys after Saviztky-Golay smoothing, MSC and outlier detection by temperature groups (n=75)
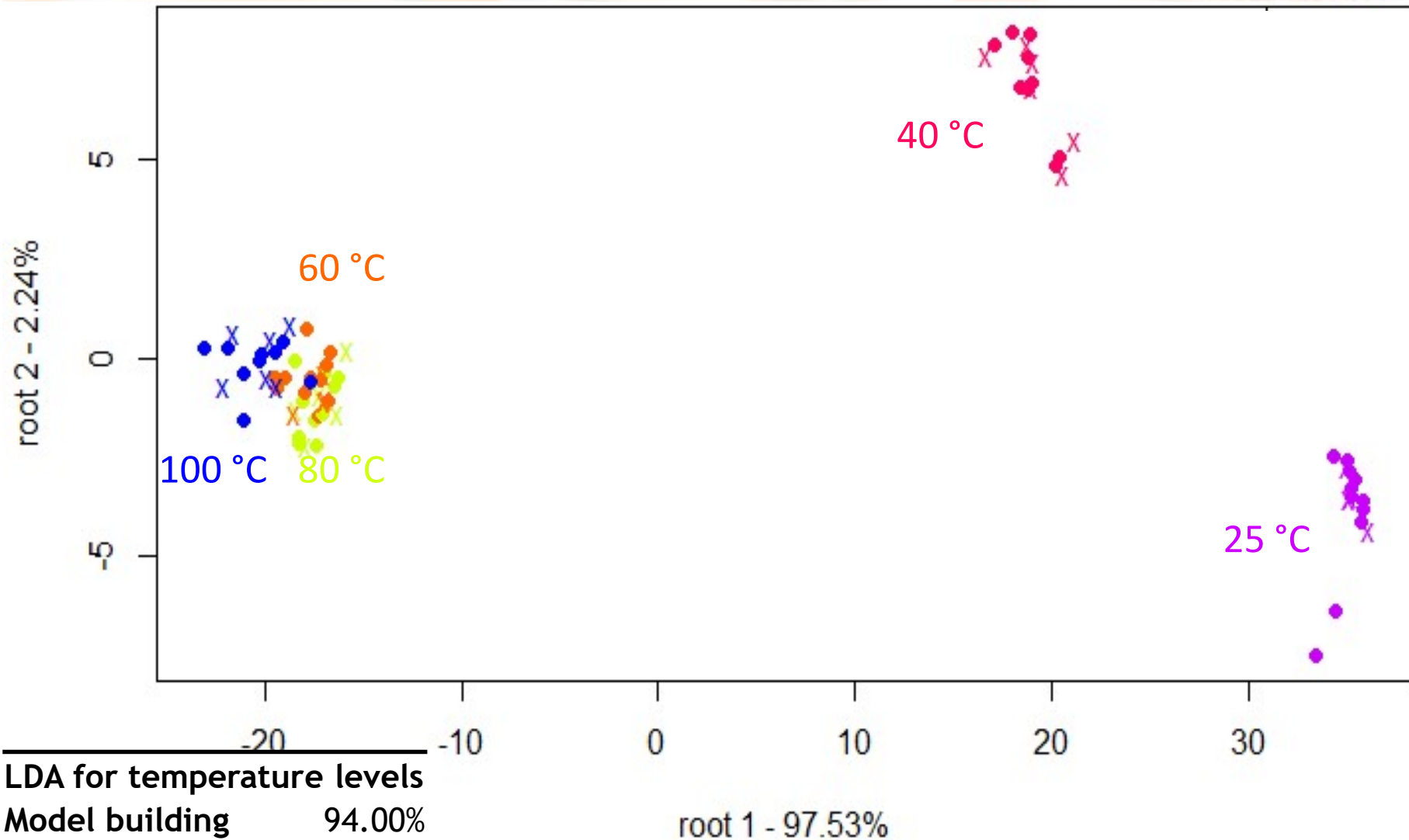
LDA for temperature levels
Model building   94.00%
Model validation   90.68%

CONCLUSION
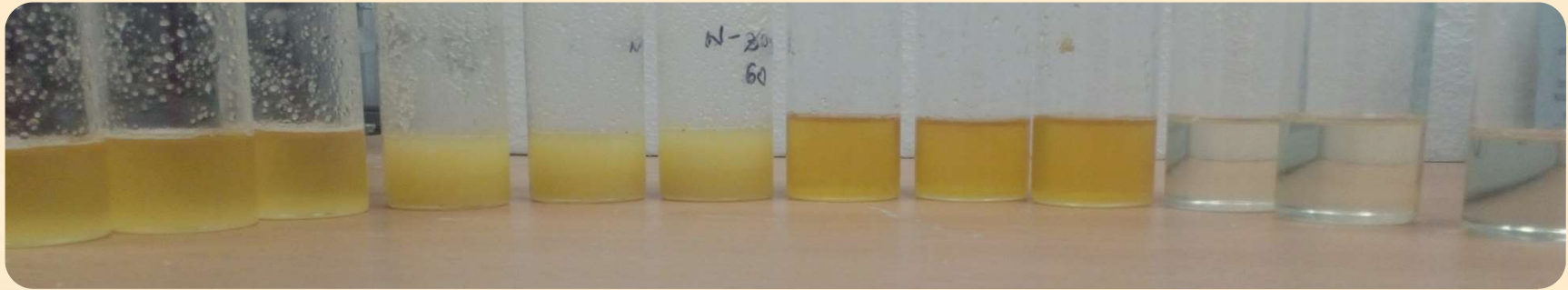
For the detection of minimal heat treatment:

- The HMF and antioxidant capacity measuring assays are not sensible enough
  - HMF at 60°C 120 min not showing significant increase
  - Antioxidant capacity is increasing
- NIR and ET were capable in of separating heated honeys from control
  - **linden**, **multiflora and sunflower** honeys

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