# Analysis Report    Honey-Profiling™

## Sample ID: PI2407150255

**Information/Declaration provided by customer:**

| | |
|---|---|
| Type of Sample: | Honey |
| Type of Honey: | Unknown |
| Botanical Variety: | undefined |
| Geographical Origin: | India |

*Disclaimer: this information will affect the applicability and validity of analyses and results.*

*Note: it is important to fill in these information in a correct and precise manner (e.g. variety in case of monofloral honey, and country of origin). The tests applied (and therefore the results received) are different from one type of honey to the other. Bruker does not take responsibility for wrong or incomplete information given by the customer.*

| | |
|---|---|
| Measuring Date: | 17-Jul-2024 14:53:33 |
| Reporting Date: | 17-Jul-2024 15:02:15, 13 pages, Version 3.1.3 |

## Results Summary

| Type of Analysis | Result | Status |
|---|---:|:---:|
| **Origin, Type and Variety** | | |
|    Type of Honey | Blossom | ⚪ |
|    Botanical Variety | Not Applied | ⚪ |
|    Country of Origin: India | Not Consistent | 🔴 |
| **Test of Markers of Foreign Sugars** | Pass | 🟢 |
| **Composition and Comparison to Reference Group** | Requires Interpretation | 🟡 |
| **Compliance for EU Market for** | | |
|    HMF | Compliant | 🟢 |
|    Sucrose | Compliant | 🟢 |
|    Glucose + Fructose | Compliant | 🟢 |

The data analysis is performed at Bruker BioSpin GmbH (Ettlingen, Germany) according to testing method AA-72-03-18 (Honey-Profiling 3.1.3), released on 09-Nov-2023 (DIN EN ISO/IEC 17025:2018 Accreditation Certificate D-PL-19229-01-00). All results solely refer to the tested sample as provided by the customer.
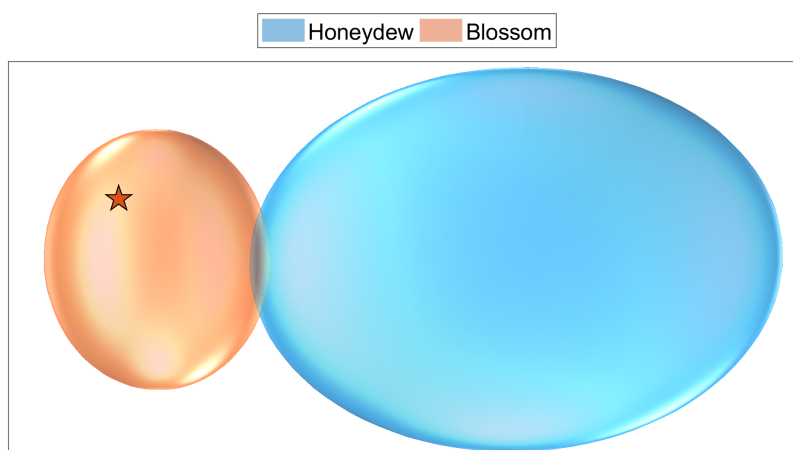
# Origin, Type and Variety

## Type of Honey

This model is based on 14146 samples, thereof 1993 samples of reference group *Honeydew*.

**Result:** Consistent with *Blossom*. The probability of consistency is 100.0%.



## Botanical Variety

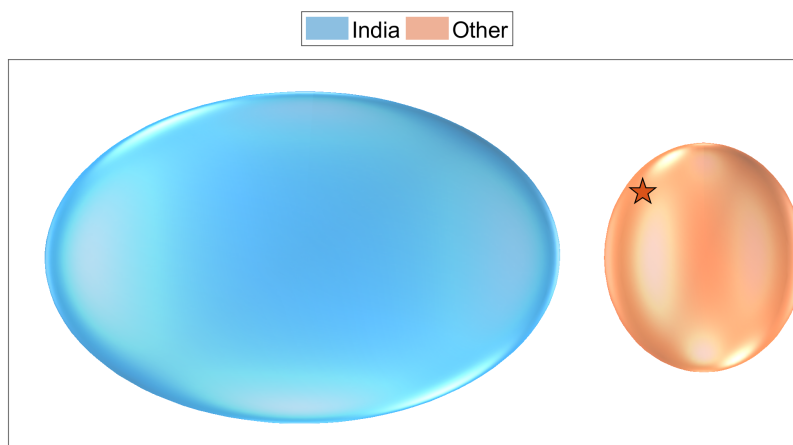Verification of consistency is not possible as the declared botanical variety of the sample is unknown or Polyfloral.

## Country of Origin: India

This model is based on 25067 samples, thereof 744 samples of reference group *India*.

**Result: Not** consistent with declared country *India*. The probability of consistency is 0.0%.
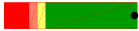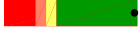
# Test of Markers of Foreign Sugars

(Analysis-ID: HO-TAD-01/0833)

Following tests have been applied in order to detect foreign sugars:

| ID | Description | Value | Graphics | Result |
|-----|----------------------|------------|----------|--------|
| 2 | 3.8113 / (1.95-2.02) | 12.38 | | pass |
| 3 | 3.9238 / (3.16-4.14) | 0.0004819 | | pass |
| 4 | 3.2890 / (1.95-2.02) | 1.431 | | pass |
| 5 | 4.0363 / (3.75-3.80) | 0.00643 | | pass |
| 6 | 5.3324 / (5.27-5.30) | 0.0660 | | pass |
| 7 | 3.0123 / (1.95-2.02) | 0.01378 | | pass |
| 8 | 3.5929 | 1694 | | pass |
| 9 | 5.0745 / (4.07-4.12) | 0.003556 | | pass |
| 10 | 3.2753 | 231.2 | | pass |
| 11 | 3.7490 / (1.95-2.02) | 0.14 | | pass |
| 13 | 4.1961 / (3.16-4.14) | 0.0001079 | | pass |
| 14 | 3.3135 / (5.27-5.30) | 0.0197 | | pass |
| 15 | 4.6809 / (3.65-3.73) | 0.00013698 | | pass |
| 16 | 3.7715 / (3.65-3.73) | 0.04890 | | pass |
| 17 | 5.4913 / (4.60-4.67) | 0.001919 | | pass |
| 18 | 4.6327 / (3.16-4.14) | 0.0004809 | | pass |
| 19 | 4.2569 / (1.95-2.02) | 0.0292 | | pass |
| 20 | 3.2797 | 165.0 | | pass |
| 127 | 4.2487 | 133.6 | | pass |
| 128 | 5.3045 / (1.95-2.02) | 0.1024 | | pass |
| 129 | 3.5884 / (3.75-3.80) | 0.004975 | | pass |
| 130 | 4.9421 / (4.93-4.97) | 0.1522 | | pass |
| 131 | 3.5929 / (4.07-4.12) | 0.01225 | | pass |
| 133 | 4.9433 / (4.93-4.97) | 0.07545 | | pass |
| 134 | 4.2501 | 55.4 | | pass |
| 135 | 3.9156 / (4.07-4.12) | 0.02863 | | pass |
| 136 | 5.2876 / (4.07-4.12) | 0.002688 | | pass |
| 140 | 3.2852 / (4.07-4.12) | 0.006249 | | pass |
| 142 | 4.3176 / (5.27-5.30) | 0.02001 | | pass |
| 143 | 5.3371 / (5.27-5.30) | 0.01713 | | pass |
| 144 | 4.4347 / (4.07-4.12) | 0.0002241 | | pass |
| 155 | 4.1511 | 447.1 | | pass |
| 156 | 3.3701 / (3.20-3.22) | 0.08911 | | pass |
| 157 | 4.1781 / (4.07-4.12) | 0.0008987 | | pass |
| 158 | 3.9283 / (5.27-5.30) | 0.0750 | | pass |

| ID | Description | Value | Graphics | Result |
|---|---|---|---|---|
| 159 | 3.9246 / (5.20-5.25) | 0.02227 | | pass |
| 162 | 3.1784 / (5.20-5.25) | 0.004483 | | pass |
| 163 | 3.5929 / (3.16-4.14) | 0.0006181 | | pass |
| 166 | 3.6627 / (4.07-4.12) | 0.03577 | | pass |
| 167 | 3.2977 / (4.07-4.12) | 0.003099 | | pass |
| 168 | 3.3753 / (4.60-4.67) | 0.1687 | | pass |
| 169 | 3.7579 / (3.65-3.73) | 0.12001 | | pass |
| 170 | 3.8885 / (3.75-3.80) | 0.04902 | | pass |
| 171 | 4.1651 / (1.95-2.02) | 1.502 | | pass |
| 172 | 3.1637 | 19.307 | | pass |
| 191 | 3.7932 / (4.07-4.12) | 0.2373 | | pass |
| 1000 | min. fructose/glucose | 1.47 | | pass |
| 1001 | max. fructose/glucose | 1.47 | | pass |
| 1002 | turanose [g/100g] | 2.03 | | pass |
| 1003 | sucrose [g/100g] | 1.4 | | pass |
| 1004 | total sugar [g/100g] | 72.6 | | pass |
| 1005 | proline [mg/kg] | 636 | | pass |
| 1006 | DHA(D), mannose(M) [mg/kg] | D=0.0, M=39 | | pass |

**Result:** There are no indications for the presence of foreign sugars.

**Notes:**

- The column *ID* is the marker's identification number.

- The column *Description* indicates either the NMR spectral region(s) (in ppm) concerned by the marker, or the molecule when it has been identified.

- The column *Value* is the result obtained for the marker.

- For columns *Graphics* and *Result* please refer to detailed description in section "General Remarks" at the end of this report.

# DHA and Mannose

| Compound | Value | Unit | LOQ | Reference Range | Flag |
|---|---|---|---|---|---|
| mannose | <LOQ | g/100g | 0.02 | <0.02 g/100g in reference dataset | 🟢 |
| dihydroxyacetone (DHA) | <LOQ | mg/kg | 5 | <5 ⎹ 16 | 🟢 |

Note: the reference range is based on *327 India* samples in the Honey-Profiling Database.

**Guideline:**

- Mannose is a mono saccharide not found in honeys with a pH value lower than 5, but that is regularly found in industrial sugars. In rare cases, however, the presence of mannose cannot be excluded for certain geographic origins and/or botanical varieties. A concentration of mannose exceeding 0.02 g/100g in honey with a pH $< 5$ could indicate the presence of foreign sugars or industrial processing practices which are not suitable for honey. An expert interpretation is suggested when mannose is present in the honey.

- Dihydroxyacetone and/or methylglyoxal are only known to be naturally present in Leptospermum genus honeys from Australia and New Zealand. A concentration exceeding 5 mg/kg in other types of honey is not typical and could indicate the presence of foreign sugars or industrial processing practices which are not suitable for honey. An expert interpretation is suggested in such cases.

- DHA and mannose are often observed simultaneously in various types of sugar syrups.

Deviations in the sugar profile, fermentation parameters and comparison to reference group could also indicate adulterations. Please check the section "Composition and Comparison to reference group" in addition.
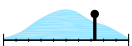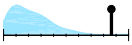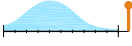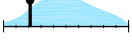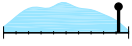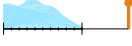
# Composition and Comparison to Reference Group

## Quantitative Analysis of Compounds
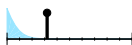
(Analysis-ID: HO-Q/3.1.0)

Parameters labelled with * are calculated parameters. The reference range is based on *327 India* samples in the Honey-Profiling Database.
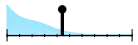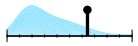
**Sugars:**

| Compound | Value | Unit | LOQ | Reference Range | Flag |
|---|---|---|---|---|---|
| glucose + fructose * | 72.6 | g/100g | 20.0 | 60.0 — 77.2 | 🟢 |
| fructose / glucose * | 1.47 | - | - | 0.96 — 1.55 | 🟢 |
| fructose | 43.2 | g/100g | 10.0 | 31.4 — 42.2 | 🟡 |
| glucose | 29.4 | g/100g | 10.0 | 26.9 — 38.6 | 🟢 |
| sucrose | 1.4 | g/100g | 0.5 | <0.5 g/100g in reference dataset | 🟡 |
| turanose | 2.03 | g/100g | 0.2 | 0.5 — 2.2 | 🟢 |
| maltose | 2.9 | g/100g | 0.5 | <0.5 — 2.0 | 🟡 |
| melezitose | <LOQ | g/100g | 1.0 | <1.0 g/100g in reference dataset | 🟢 |
| maltotriose | <LOQ | g/100g | 1.0 | <1.0 g/100g in reference dataset | 🟢 |
| gentiobiose | <LOQ | g/100g | 0.3 | <0.3 g/100g in reference dataset | 🟢 |
| raffinose | 0.1 | g/100g | 0.1 | 0.1 — 0.3 | 🟢 |
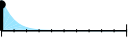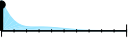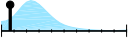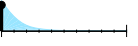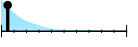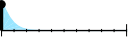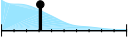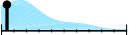
**Acids:**

| Compound | Value | Unit | LOQ | Reference Range | Flag |
|---|---|---|---|---|---|
| citric acid | 86 | mg/kg | 50 | <50 — 162 | 🟢 |
| malic acid | <LOQ | mg/kg | 100 | <100 — 115 | 🟢 |
| quinic acid | <LOQ | mg/kg | 300 | <300 mg/kg in reference dataset | 🟢 |
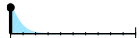
**Amino Acids:**

| Compound | Value | Unit | LOQ | Reference Range | Flag |
|---|---|---|---|---|---|
| alanine | 13 | mg/kg | 5 | <5 ... 24 | 🟢 |
| aspartic acid | <LOQ | mg/kg | 150 | <150 mg/kg in reference dataset | 🟢 |
| glutamine | <LOQ | mg/kg | 200 | <200 mg/kg in reference dataset | 🟢 |
| leucine | <LOQ | mg/kg | 40 | <40 ... 110 | 🟢 |
| proline | 636 | mg/kg | 200 | 225 ... 863 | 🟢 |
| valine | <LOQ | mg/kg | 10 | <10 ... 14 | 🟢 |
| tyrosine | <LOQ | mg/kg | 50 | <50 ... 150 | 🟢 |
| phenylalanine | <LOQ | mg/kg | 100 | <100 ... 568 | 🟢 |

**Indicators for Fermentation and Processing:**

| Compound | Value | Unit | LOQ | Reference Range | Flag |
|---|---|---|---|---|---|
| 2,3-butanediol | <LOQ | mg/kg | 20 | <20 ... 327 | 🟢 |
| 5-hydroxymethylfurfural (HMF) | <LOQ | mg/kg | 5 | <5 ... 122 | 🟢 |
| acetic acid | 17 | mg/kg | 10 | <10 ... 113 | 🟢 |
| acetoin | <LOQ | mg/kg | 20 | <20 ... 187 | 🟢 |
| ethanol | <LOQ | mg/kg | 5 | <5 ... 3283 | 🟢 |
| lactic acid | 21 | mg/kg | 10 | <10 ... 234 | 🟢 |
| formic acid | 65 | mg/kg | 5 | <5 ... 113 | 🟢 |
| fumaric acid | <LOQ | mg/kg | 5 | <5 ... 7 | 🟢 |
| pyruvic acid | 17 | mg/kg | 10 | <10 ... 32 | 🟢 |
| succinic acid | 11 | mg/kg | 5 | 8 ... 94 | 🟢 |

**Markers:**

| Compound | Value | Unit | LOQ | Reference Range | Flag |
|---|---|---|---|---|---|
| 3-phenyllactic acid | <LOQ | mg/kg | 300 | <300 mg/kg in reference dataset | 🟢 |
| methylglyoxal (MGO) | <LOQ | mg/kg | 30 | <30 ⎰⎰⎰ 33 | 🟢 |
| kynurenic acid | <LOQ | mg/kg | 60 | <60 mg/kg in reference dataset | 🟢 |
| shikimic acid | <LOQ | mg/kg | 80 | <80 mg/kg in reference dataset | 🟢 |

**Guideline:**

- Values of fructose/glucose ratio exceeding 1.95 or below 0.85 are not typical for honey and could indicate the presence of sugar syrups.

- Low concentrations of turanose (less than 0.35 g/100g) is a marker for the presence of foreign sugars (see section "Markers of Foreign Sugars").

- Atypical concentrations of sugars in comparison to reference range can be related to foreign sugars/adulteration or to the botanical varieties present in the honey. Expert interpretation is suggested.

- The presence of gentiobiose is common for Linden Tree honey.

- The presence of quinic acid is common for honeydew.

- HMF is a sugar degradation product formed under influence of heat. According to EU-Directive (2001/110/EC), HMF can be found naturally in honey in concentrations up to 80 mg/kg in regions with tropical climate. A higher concentration of HMF is due to processing of honey which can sometime correlate with adulterations. A concentration of HMF exceeding 200 mg/kg should be regarded as suspicious.

- Concentration of ethanol exceeding 400 mg/kg indicates fermentation of the honey, which could be related to unripe honey.

- Acetoin can be elevated in Eucalyptus honey.

- The presence of kynurenic acid is common for Chestnut honey.

- The presence of shikimic acid is common for honeydew.

## Statistical Comparison with the Reference Group

The models are based on 327 samples from *India* in the Honey-Profiling Database.

### Univariate Verification

**Applied Model:** India

**Result:** Not typical for India.

$3.591^{high}$ $4.186^{high}$ $4.208^{high}$ $5.379^{high}$ $5.383^{high}$ $5.388^{high}$ $5.392^{high}$ $5.397^{high}$ $5.406^{high}$ $5.599^{high}$ $5.604^{high}$

The suffix *high* indicates that the intensity is higher than in the reference group, the suffix *low* indicates that the intensity is lower than in the reference group.

**Possible molecules:** 2,3-Butanediol, Fructose, Gentiobiose, Maltotriose, Mannose, Melezitose, Proline, Quinic acid, Raffinose, Sucrose, Turanose

This list gives indication about possible molecules responsible for deviations.

### Multivariate Verification

**Applied Model:** India

**Result:** Typical for India.
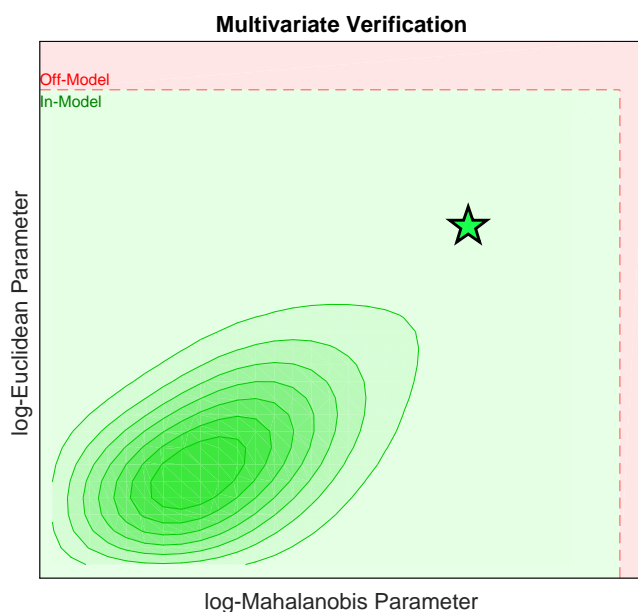
# Codex Alimentarius and EU-Directive 2001/110/EC:

Following parameters are required according to Codex Alimentarius and EU-Directive 2001/110/EC. The concentrations are obtained by direct quantification. Parameters labelled with * are calculated parameters.

| Compound | Value | Unit | LOQ | Official Reference min | Official Reference max | Flag |
|---|---|---|---|---|---|---|
| glucose + fructose * | 72.6 | g/100g | 20.0 | 45 | - | 🟢 |
| sucrose | 1.4 | g/100g | 0.5 | - | 15 | 🟢 |
| 5-hydroxymethylfurfural (HMF) | <LOQ | mg/kg | 5 | - | 80 | 🟢 |

Following flags are used according to Codex Alimentarius and EU-Directive 2001/110/EC:

| Compound | Flag | Concentration | Declaration | Interpretation |
|---|---|---|---|---|
| glucose + fructose | 🔴 | < 45 g/100g | All | Not compliant |
| | | < 60 g/100g | Blossom | Not compliant for blossom honey |
| | 🟢 | ≥ 60 g/100g | All | Compliant |
| | | ≥ 45 g/100g | Honeydew | Compliant for honeydew honey |
| | 🟡 | ≥ 45 g/100g, < 60 g/100g | Unknown | Compliant for honeydew honey and blends of honeydew honey with blossom honey. Not compliant for blossom honey. |
| sucrose | 🔴 | > 15 g/100g | All | Not compliant |
| | | 10-15 g/100g | Acacia, Eucalyptus | Not compliant for false acacia (*Robinia pseudoacacia*), and red gum (*Eucalyptus camadulensis*) |
| | 🟢 | ≤ 5 g/100g | All | Compliant |
| | | ≤ 10 g/100g | Acacia, Eucalyptus | Compliant for false acacia (*Robinia pseudoacacia*), and red gum (*Eucalyptus camadulensis*) |
| | | ≤ 15 g/100g | Lavender | Compliant for *Lavandula spp.* |
| | 🟡 | 5-10 g/100g | All, except Acacia, Eucalyptus, Lavender | If ≤ 15g/100g: compliant for lavender (*Lavandula spp.*) and borage (*Borago officinalis*). If ≤ 10g/100g: compliant for false acacia (*Robinia pseudoacacia*), alfalfa (*Medicago sativa*), Menzies Banksia (*Banksia menziesii*), French honeysuckle (*Hedysarum*), red gum (*Eucalyptus camadulensis*), leatherwood (*Eucryphia lucida, Eucryphia milliganii*) and *Citrus spp.* |
| HMF | 🔴 | > 80 mg/kg | All, except Industrial honey | Not compliant, except for baker's honey |
| | 🟢 | ≤ 40 mg/kg | All | Compliant |
| | | > 80 mg/kg | Industrial honey | Compliant for baker's honey |
| | 🟡 | 40-80 mg/kg | All | Not compliant, except for baker's honey and honeys of declared origin from regions with tropical climate and blends of these honeys |

# General Remarks

### Targeted Markers for Foreign Sugars

This test aims at detecting foreign sugars. It does rely on the analysis of the concentrations of certain known molecules and on absolute intensities or intensities ratios of marker peaks. The Honey-Profiling report contains several tens of markers. Some of these markers are independent on the variety and the origin, in order to be able to analyze blends, while there are also many markers specific to countries or varieties.

The values obtained for each marker are compared to the thresholds for purity.

Reported and visualized results:

- Result **Pass** (green):
  Markers with an upper limit: The value of the marker is below the acceptance limit
  Markers with a lower limit: The value of the marker is above the acceptance limit
  Conclusion: There are no indications for the presence of foreign sugars.

- Result **Conditional Pass** (yellow):
  The value of the marker is between the acceptance limit and the threshold
  Conclusion: There is no indication for the presence of foreign sugars. However, for one or more markers the determined values are close to the threshold.

- Result **Conditional Fail**: (orange)
  The value of the marker is between the threshold and the tolerance limit
  Conclusion: There is a strong indication for the presence of foreign sugars. However, the determined values are close to the threshold. It is recommended to perform additional tests in order to better evaluate the risk.

- Result **Fail**: (red)
  Markers with an upper limit: The value of the marker is above the tolerance limit
  Markers with a lower limit: The value of the marker is below the tolerance limit
  Conclusion: There is a strong indication for the presence of foreign sugars.

The black dot represents the current sample.
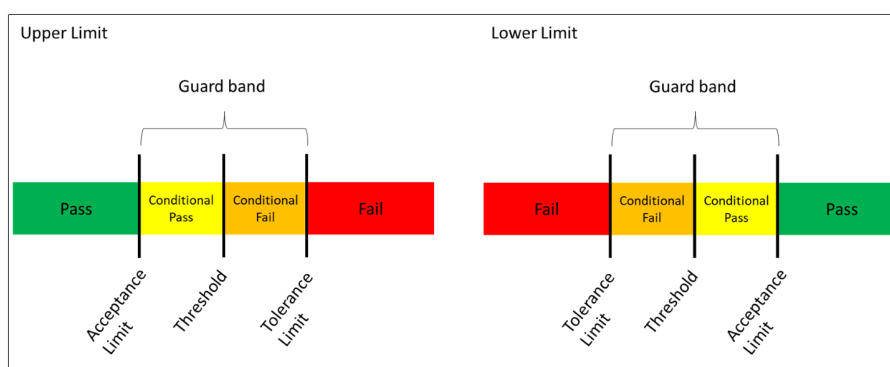


Presence of foreign sugars is due to deliberate dilution of honey with sugar syrups or wrong beekeeping practices in terms of artificial feeding of bees.

All conformity statements in this section are based on the "Non Binary Statement with Guard Band" according to ILAC G8:09/2019. Please find in the following table the values for acceptance limit (conditional pass), threshold (conditional fail) and tolerance limit (fail).

| ID | Description | Conditional Pass | Conditional Fail | Fail |
|----|-------------|-----------------:|-----------------:|-----:|
| 2 | 3.8113 / (1.95-2.02) | >68.95 | >69.44 | >69.92 |
| 3 | 3.9238 / (3.16-4.14) | <0.0003172 | <0.0003039 | <0.0002905 |
| 4 | 3.2890 / (1.95-2.02) | >5.792 | >5.838 | >5.884 |
| 5 | 4.0363 / (3.75-3.80) | >0.01113 | >0.01131 | >0.01148 |
| 6 | 5.3324 / (5.27-5.30) | >0.1683 | >0.1703 | >0.1723 |
| 7 | 3.0123 / (1.95-2.02) | >0.06929 | >0.07134 | >0.07340 |

| ID | Description | Conditional Pass | Conditional Fail | Fail |
|----|-------------|------------------:|------------------:|------:|
| 8 | 3.5929 | >2186 | >2227 | >2269 |
| 9 | 5.0745 / (4.07-4.12) | <0.001662 | <0.001495 | <0.001329 |
| 10 | 3.2753 | >407.8 | >414.9 | >422.0 |
| 11 | 3.7490 / (1.95-2.02) | >11.53 | >11.56 | >11.59 |
| 13 | 4.1961 / (3.16-4.14) | >0.0002284 | >0.0002327 | >0.0002369 |
| 14 | 3.3135 / (5.27-5.30) | >0.1677 | >0.1717 | >0.1757 |
| 15 | 4.6809 / (3.65-3.73) | <0.00009264 | <0.00008224 | <0.00007184 |
| 16 | 3.7715 / (3.65-3.73) | >0.06283 | >0.06399 | >0.06515 |
| 17 | 5.4913 / (4.60-4.67) | >0.002301 | >0.002341 | >0.002380 |
| 18 | 4.6327 / (3.16-4.14) | <0.0003476 | <0.0003379 | <0.0003282 |
| 19 | 4.2569 / (1.95-2.02) | >0.7715 | >0.7759 | >0.7803 |
| 20 | 3.2797 | >262.1 | >268.0 | >273.9 |
| 127 | 4.2487 | >366.4 | >382.3 | >398.2 |
| 128 | 5.3045 / (1.95-2.02) | >0.6017 | >0.6092 | >0.6168 |
| 129 | 3.5884 / (3.75-3.80) | >0.006261 | >0.006470 | >0.006679 |
| 130 | 4.9421 / (4.93-4.97) | >0.1832 | >0.1862 | >0.1892 |
| 131 | 3.5929 / (4.07-4.12) | >0.01423 | >0.01446 | >0.01470 |
| 133 | 4.9433 / (4.93-4.97) | >0.08613 | >0.08758 | >0.08904 |
| 134 | 4.2501 | >237.5 | >244.2 | >251.0 |
| 135 | 3.9156 / (4.07-4.12) | <0.02216 | <0.02141 | <0.02065 |
| 136 | 5.2876 / (4.07-4.12) | >0.004380 | >0.004442 | >0.004505 |
| 140 | 3.2852 / (4.07-4.12) | >0.008687 | >0.008959 | >0.009231 |
| 142 | 4.3176 / (5.27-5.30) | >0.07307 | >0.07400 | >0.07494 |
| 143 | 5.3371 / (5.27-5.30) | >0.04644 | >0.04885 | >0.05127 |
| 144 | 4.4347 / (4.07-4.12) | <0.0001627 | <0.0001543 | <0.0001460 |
| 155 | 4.1511 | <307.6 | <268.2 | <228.8 |
| 156 | 3.3701 / (3.20-3.22) | <0.07742 | <0.07561 | <0.07380 |
| 157 | 4.1781 / (4.07-4.12) | <0.0004571 | <0.0003843 | <0.0003115 |
| 158 | 3.9283 / (5.27-5.30) | >0.4156 | >0.4226 | >0.4295 |
| 159 | 3.9246 / (5.20-5.25) | <0.01303 | <0.01167 | <0.01031 |
| 162 | 3.1784 / (5.20-5.25) | <0.002753 | <0.002590 | <0.002427 |
| 163 | 3.5929 / (3.16-4.14) | >0.0008186 | >0.0008317 | >0.0008449 |
| 166 | 3.6627 / (4.07-4.12) | <0.02052 | <0.02000 | <0.01949 |
| 167 | 3.2977 / (4.07-4.12) | <0.002394 | <0.002260 | <0.002126 |
| 168 | 3.3753 / (4.60-4.67) | >0.1892 | >0.1935 | >0.1977 |
| 169 | 3.7579 / (3.65-3.73) | <0.08739 | <0.08315 | <0.07891 |
| 170 | 3.8885 / (3.75-3.80) | <0.03880 | <0.03725 | <0.03570 |
| 171 | 4.1651 / (1.95-2.02) | >6.362 | >6.421 | >6.480 |
| 172 | 3.1637 | <10.563 | <8.554 | <6.544 |
| 191 | 3.7932 / (4.07-4.12) | >0.3806 | >0.3999 | >0.4192 |
| 1000 | min. fructose/glucose | <0.90 | <0.85 | <0.80 |
| 1001 | max. fructose/glucose | >1.90 | >1.95 | >2.00 |
| 1002 | turanose [g/100g] | <0.38 | <0.35 | <0.32 |
| 1003 | sucrose [g/100g] | >14 | >15 | >16 |
| 1004 | total sugar [g/100g] | <46 | <45 | <44 |
| 1005 | proline [mg/kg] | <171 | <160 | <149 |
| 1006 | DHA(D), mannose(M) [mg/kg] | D>3, M>150 | D>5, M>200 | D>7, M>250 |

### Classification Models

Analysis of origin, type and variety relies on a statistical classification analysis. The test applied is a classification analysis with the aim to check the consistency of the declared meta-information of the sample (geographical origin or botanical variety). The consistency with a group is expressed as posterior probability in the range from 0% to 100%. A posterior probability exceeding 50% is being regarded as consistent with the respective group. The underlying statistical models are based on a dimension reduction (Principal Component Analysis and/or Linear Discriminant Analysis used) followed by a Linear (or Quadratic) Discriminant Analysis for final classification.

Within the discrimination space figure, the ellipsoids are representing the modeling samples and the star represents the actual sample under investigation.

Verification of origin is not possible on blends from different countries.

Expert interpretation is necessary before deducing any conclusions.

All conformity statements in this section are based on the "Binary Statement for Simple Acceptance Rule" according to ILAC-G8:09/2019.

### Quantitative Analysis

Quantitative values are compared with the distribution of concentration of the reference samples in the Honey-Profiling Database, for the same type of honey. Deviations to the reference range can be linked with adulterations or with specificities of the honey (e.g. untypical floral/ plant sources or production regions). For this reason, an expert interpretation is suggested in case of deviations.

All conformity statements in this section are based on the "Binary Statement for Simple Acceptance Rule" according to ILAC-G8:09/2019.

### Univariate and Multivariate Verification Models

Verification models are non-targeted analyses comparing the whole NMR-Profile of a specific sample with one corresponding group of reference spectra (within the Honey-Profiling Database). All spectral data points are taken into account irrespective of whether the signals are caused by already identified molecules or not.

In the univariate analysis, the NMR spectrum is checked for any unusual low or high signal intensities, while taking into account the natural variability of a respective reference group. The chemical shifts (positions of the signals in the spectra) of the deviating signals are indicated. A guideline gives a list of possible molecules with their chemical shifts that could be responsible for the deviations.

The multivariate models take into account the relation between different signals in the NMR spectrum.

Deviations to the group of reference spectra can be linked with adulterations or specificities of the honey (e.g. untypical floral/ plant sources or production regions). For this reason, an expert interpretation is suggested in case of deviations.

All conformity statements in this section are based on the "Binary Statement for Simple Acceptance Rule" according to ILAC-G8:09/2019.

### FAQ - Frequently asked Questions

For more information please visit our website and read our FAQ at

http://www.bruker.com/en/products-and-solutions/mr/nmr-food-solutions/honey-profiling/honey-profiling-faq.html

---

## END OF REPORT