Bruker BioSpin GmbH

Analysis Report   Honey-Profiling™

Sample ID: PI2104080001

Information/Declaration provided by customer:

Type of Sample:	Honey
Type of Honey:	Blossom
Botanical Variety:	undefined
Geographical Origin:	India

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

Measuring Date:	08-Apr-2021 17:49:43
Reporting Date:	09-Apr-2021 08:21:28, 10 pages, Version 2.0.8

Results Summary

Type of Analysis	Result	Status
Analysis of declared information		
Origin India	Consistent	🟢
Detection of Sugar Syrups	No	🟢
Codex Alimentarius and EU-Directive 2001/110/EC	Compliant	🟢
Quantitative Analysis	Interpretation required	🟡
Non-Targeted Analysis		
Univariate Verification	Not Consistent	🔴
Multivariate Verification	Consistent	🟢

The data analysis is performed at Bruker BioSpin GmbH (Rheinstetten, Germany) according to testing method AA-72-03-08 (Honey-Profiling 2.0.8), released on 02-Mar-2021 (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.

# Analysis of declared Information

Statistical Model: Origin India

This model is based on 15946 samples, thereof 216 samples of reference group *India*.

Result: Consistent with declared country *India*. The probability of consistency is 100.0%.
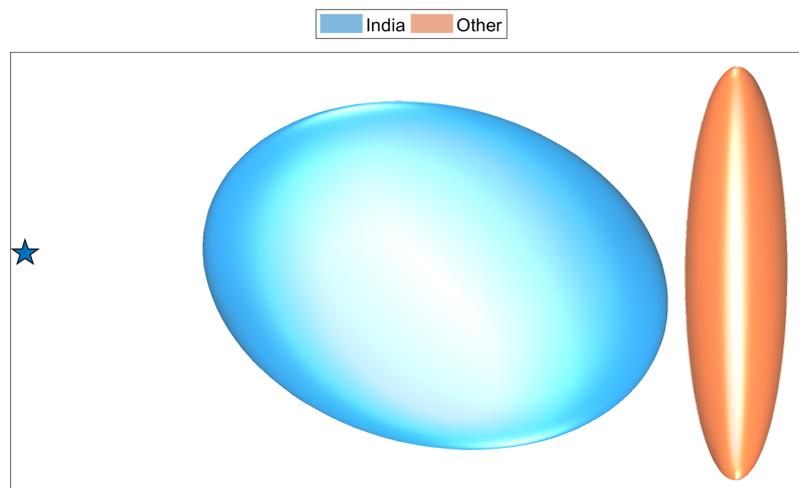
Detection of Sugar Syrups

(Analysis-ID: HO-2000-02/0167)

Following tests have been applied in order to detect sugar syrups:

Nr	Type	Description	Result	Value	Limit	Out
1	Intensity/Ratio	3.263 (absolute quantitative)	passed	509	<1279	-
2	Intensity/Ratio	5.077 (absolute quantitative)	passed	128	>39	-
3	Intensity/Ratio	3.636 (absolute quantitative)	passed	2393	<4674	-
4	Intensity/Ratio	4.262 (absolute quantitative)	passed	163	>29	-
5	Intensity/Ratio	4.195 (absolute quantitative)	passed	98	<1200	-
6	Intensity/Ratio	5.271 (absolute quantitative)	passed	25.0	>5.6	-
7	Intensity/Ratio	4.280 (absolute quantitative)	passed	53	>20	-
8	Intensity/Ratio	5.113/(3.270-3.310)	passed	0.005	<0.036	-
9	Intensity/Ratio	4.496/(3.270-3.310)	passed	0.045	>0.012	-
10	Intensity/Ratio	5.334/(5.270-5.300)	passed	0.08	<0.13	-
11	Intensity/Ratio	3.546/(5.270-5.300)	passed	1.56	>0.62	-
12	Intensity/Ratio	3.740/(5.270-5.300)	passed	3.9	>1.2	-
13	Intensity/Ratio	3.857/(5.200-5.260)	passed	0.0102	>0.0037	-
14	Intensity/Ratio	4.150 (absolute quantitative)	passed	202	>115	-
15	Intensity/Ratio	5.181 (absolute quantitative)	passed	32	>24	-
16	Intensity/Ratio	4.055/(5.030-5.070)	passed	2	<46	-
18	Intensity/Ratio	3.708/(5.030-5.070)	passed	190	<872	-
19	Intensity/Ratio	6.765/(5.250-5.270)	passed	0.009	<0.046	-
20	Intensity/Ratio	2.200/(5.305-5.315)	passed	0.426	>0.019	-
21	Intensity/Ratio	3.326/(3.270-3.310)	passed	0.118	>0.034	-
22	Intensity/Ratio	4.037/(3.270-3.310)	passed	1.35	>0.73	-
23	Intensity/Ratio	4.006/(5.270-5.300)	passed	1.24	>0.70	-
24	Intensity/Ratio	3.564/(5.270-5.300)	passed	28.3	>10.0	-
25	Intensity/Ratio	5.388/(5.370-5.400)	passed	0.17	>0.13	-
26	Intensity/Ratio	3.524/(4.075-4.110)	passed	0.061	<0.070	-
27	Intensity/Ratio	3.182/(4.075-4.110)	passed	0.0023	<0.0045	-
28	Intensity/Ratio	3.785/(4.075-4.110)	passed	0.056	>0.036	-
29	Intensity/Ratio	3.857/(4.075-4.110)	passed	0.0059	>0.0021	-
30	Intensity/Ratio	4.267/(4.970-4.990)	passed	4.1	<4.7	-
31	Intensity/Ratio	4.276/(4.970-4.990)	passed	1.2	<5.4	-
32	Intensity/Ratio	4.204/(5.090-5.110)	passed	1.1	<5.7	-
33	Intensity/Ratio	4.249 (absolute quantitative)	passed	71	<380	-
35	Intensity/Ratio	3.524/(5.250-5.270)	passed	34	<97	-
36	Intensity/Ratio	5.113/(5.250-5.270)	passed	0.03	<0.19	-
37	Intensity/Ratio	5.091/(5.090-5.110)	passed	0.39	<0.48	-
49	Quantification	Fructose/Glucose	passed	1.23	>0.85 **and** <1.95	-
50	Quantification	Fructose+Glucose	passed	68.4	>40	-
51	Quantification	Turanose	passed	1.10	>0.3	-
52	Quantification	DHA(D) and Mannose(M)	passed	21 / 0.000	D<30 **or** M<0.05	-
53	Quantification	Sucrose	passed	0.0	<15	-

Result: There are no indications for the presence of sugar syrups.

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	max	Flag
glucose + fructose *	68.4	g/100g	20.0	60	-	🟢
sucrose	<LOQ	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

Quantitative Analysis

In the following table the results of the quantitative analysis are given. The concentrations are obtained by direct quantification. Parameters labelled with * are calculated parameters. The reference range is derived from the *India Blossom* samples in the Honey-Profiling Database. The reference range bases on 105 samples.

Sugars:

Compound	Value	Unit	LOQ	Reference Range	Flag
glucose + fructose *	68.4	g/100g	20.0	64.7 — 80.1	🟢
fructose / glucose *	1.23	-	-	0.95 — 1.67	🟢
fructose	37.7	g/100g	10.0	34.2 — 44.1	🟢
glucose	30.7	g/100g	10.0	24.8 — 40.0	🟢
sucrose	<LOQ	g/100g	0.5	<0.5 g/100g in reference dataset	🟢
turanose	1.1	g/100g	0.2	0.3 — 2.3	🟢
maltose	1.3	g/100g	0.5	<0.5 — 2.1	🟢
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	<LOQ	g/100g	0.1	0.1 — 0.3	🟢
mannose	<LOQ	g/100g	0.05	<0.05 — 0.06	🟢
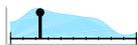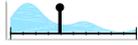
Acids:

Compound	Value	Unit	LOQ	Reference Range	Flag
citric acid	69	mg/kg	50	<50 — 370	🟢
malic acid	<LOQ	mg/kg	100	<100 — 114	🟢
quinic acid	<LOQ	mg/kg	300	<300 mg/kg in reference dataset	🟢

Amino Acids:

Compound	Value	Unit	LOQ	Reference Range	Flag
alanine	21	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 ... 132	🟢
proline	946	mg/kg	150	237 ... 891	🟡
valine	<LOQ	mg/kg	10	<10 ... 13	🟢
tyrosine	<LOQ	mg/kg	50	<50 ... 150	🟢
phenylalanine	<LOQ	mg/kg	100	<100 ... 763	🟢
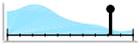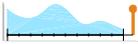
Indicators for Fermentation, Processing and Origin:

Compound	Value	Unit	LOQ	Reference Range	Flag
2,3-butanediol	168	mg/kg	20	<20 ... 89	🟡
5-hydroxymethylfurfural (HMF)	<LOQ	mg/kg	5	<5 ... 81	🟢
acetic acid	101	mg/kg	10	11 ... 84	🟡
acetoin	150	mg/kg	20	<20 ... 166	🟢
ethanol	28	mg/kg	5	<5 ... 365	🟢
lactic acid	423	mg/kg	10	<10 ... 153	🟡
formic acid	77	mg/kg	5	30 ... 132	🟢
fumaric acid	<LOQ	mg/kg	5	<5 ... 7	🟢
pyruvic acid	29	mg/kg	10	<10 ... 28	🟡
succinic acid	21	mg/kg	5	<5 ... 45	🟢
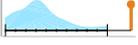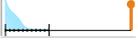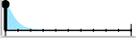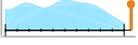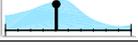
Markers:

Compound	Value	Unit	LOQ	Reference Range	Flag
3-phenyllactic acid	<LOQ	mg/kg	300	<300 mg/kg in reference dataset	🟢
dihydroxyacetone (DHA)	21	mg/kg	20	<20 22	🟢
methylglyoxal (MGO)	<LOQ	mg/kg	30	<30 mg/kg in reference dataset	🟢
kynurenic acid	<LOQ	mg/kg	60	<60 mg/kg in reference dataset	🟢
shikimic acid	<LOQ	mg/kg	80	<80 mg/kg in reference dataset	🟢

Guidelines for Interpretation

- Mannose is a mono saccharide not typical for honey but that is regularly found in industrial syrups. In rare cases, however, the presence of mannose cannot be excluded for certain geographic and/or botanical origins, e.g. for honey containing also honeydew. For blossom honey, a concentration of mannose exceeding 0.05 g/100g could indicate addition of syrup or types of industrial processing which are not suitable for honey. Expert interpretation is suggested in case the presence of mannose.

- Dihydroxyacetone and/or methylglyoxal are only typical for Manuka honeys from Ozeania. Occurence exceeding 30 mg/kg in other types of honey is not typical and could indicate addition of syrup or types of industrial processing which are not suitable for honey; expert interpretation is needed in such cases.

- For monofloral Manuka honey, the concentration of 3-phenyllactic acid should exceed 400 mg/kg.

- Low concentration values of proline (less than 180 mg/kg) could indicate addition of syrup or usage of unripe honey.

- Concentration of ethanol exceeding 400 mg/kg indicates fermentation.

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

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

- The presence of shikimic acid is common for honeydew.

- The presence of quinic acid is common for honeydew.

Non-Targeted Verification Analysis

Univariate Verification

Applied Model: India Blossom

**Result:** Deviating signals were found at following chemical shifts:

1.115^{high} 1.129^{high} 1.385^{high} 1.390^{high} 1.394^{high} 1.403^{high} 1.408^{high} 1.412^{high} 1.426^{high} 1.430^{high} 2.304^{high} 5.856^{high}

Multivariate Verification

Applied Model: India Blossom

Result: No deviation was detected in multivariate verification (In-Model).
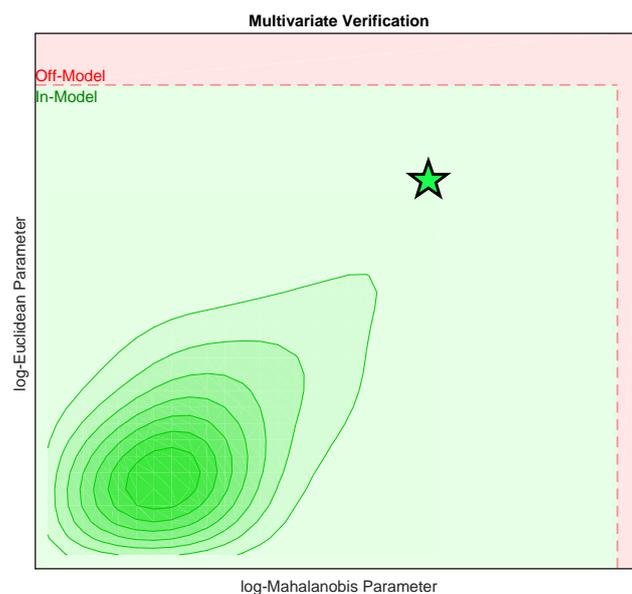
General Remarks

Analysis of declared Information

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 Linear Discriminant Analysis for dimension reduction 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.

Expert interpretation is necessary before deducing any conclusions.

Quantitative Analysis

Quantitative values are compared to the reference honey database (visualised by distribution). Deviations to the reference distributions do not necessarily indicate an adulteration. Fermentation or specific botanical varieties can also create deviations. Therefore, expert interpretation is necessary before deducing any conclusions.

Non-Targeted Verification Analysis

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

There are different possible reasons for any deviation from the group of reference spectra. If there are detected deviations, this does not automatically mean, that the sample is adulterated. Expert interpretation is necessary before deducing any conclusions.

In the univariate analysis, the NMR spectrum is checked for any unusual low or high signal intensities for a given sample, while taking into account the natural variability of a respective reference group. Multivariate models also take into account the relation between different signals in the NMR spectrum.