

Nov 13th
2019



**UK Market & B.H.I.P.A.
B.H.I.P.A. Position on NMR
Issues
General
Conclusions**

UK Market & B.H.I.P.A.



It is estimated that the UK has just under 40,000 beekeepers however the vast majority are hobbyists averaging just over 6 hives each.

Domestic production is low and very limited quantities are made commercially available.

UK imports run to 45,000 to 50,000 MT annually are required to meet demand and are sourced from both EU and Non EU origins.

Honey Association members account for over 90% of the quantities imported and packed in the UK.

The market is predominantly retail and Members are open to and audited on a continuous basis adhering to retailer COP's.

Members work to relevant BRC and food safety standards possessing robust and regularly challenged traceability systems back to beekeeper.

BHIPA Code of Practice states -

The Association is concerned to guard the reputation of honey as a pure wholesome food and totally deplores any attempt to adulterate the product or make false claims about its geographical or floral origin

It is a condition of membership of the Honey Association (British Honey Importers and Packers Association) that members must under no circumstances adulterate or knowingly falsely describe the product

Importers will take all reasonable steps and exercise all due diligence to ensure the imported product is not adulterated or falsely described and otherwise complies with the requirements of the Legislation and Contracted Conditions

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- CODEX STANDARD FOR HONEY CODEX STAN 12-1981
- Honey defined by “The Honey Regulations 2015” (Council Directive 2001/110/EC and subsequent amendments) - introduction, names/descriptions, compositional requirements, labelling and enforcement
- http://www.legislation.gov.uk/uksi/2015/1348/pdfs/uksi_20151348_en.pdf
- To be revised in line with UK exit from EU, consultation completed and awaiting EU exit
- Honey through the supply chain undergoes a number of tests to ensure it conforms with the composition criteria as laid out in legislation and in specifications as well as for the detection of antibiotic and pesticide residues along with pollen, colour, chemical/biological and organoleptic properties as required
- Tests evolve and are added to specifications over and above those set out in CODEX/Honey Regs e.g. EA/LC-IRMS, DHA/MGO etc.
- The authenticity of Honey is determined by a number of complimentary methods used in conjunction with organoleptic, chemical and other tests where applicable and should be accompanied by readily available and clear traceability to the beekeeper

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EU Control Plan on Honey and JRC (2015 – 17) - objective to assess the prevalence on the market of honeys adulterated with sugars and honeys mislabelled with regard to their botanical source or geographical origin

| | EU | | EU Total | UK | | UK Total |
|---------------------|-------------|------------|-------------|-------------|------------|-------------|
| | Non Cmplnt. | Suspicious | | Non Cmplnt. | Suspicious | |
| Phy/Chem | 2% | | 2% | 0.0% | 0.0% | 0% |
| Botanical | 7% | | 7% | 4.1% | 0.0% | 4% |
| Geographical | 2% | 2% | 4% | 0.0% | 1.4% | 1% |
| Sugar | 6% | 11% | 17% | 1.4% | 0.7% | 2% |
| Other | 2% | | 2% | 0.0% | 0.0% | 0% |
| Total | 19% | 13% | 32% | 5.4% | 2.0% | 7% |
| Samples | 425 | 291 | 716 | 8 | 3 | 11 |

| Non - Compliant | UK | Phy/Chem | Botanical | Geographical | Sugar | Other | Total |
|------------------------------|------------|----------|-----------|--------------|----------|----------|----------|
| Part A (MS) | 30 | | 2 | | | | 2 |
| Part B (Not MS, not bl.) | 66 | | 3 | | 1 | | 4 |
| Part C (Bl. EU, Non EU etc.) | 51 | | 1 | | 1 | | 2 |
| Total | 147 | 0 | 6 | 0 | 2 | 0 | 8 |
| | | 0.0% | 4.1% | 0.0% | 1.4% | 0.0% | 5.4% |

| Suspicious | UK | Phy/Chem | Botanical | Geographical | Sugar | Other | Total |
|------------------------------|------------|----------|-----------|--------------|----------|----------|----------|
| Part A (MS) | 30 | | | 2 | | | 2 |
| Part B (Not MS, not bl.) | 66 | | | | 1 | | 1 |
| Part C (Bl. EU, Non EU etc.) | 51 | | | | | | 0 |
| Total | 147 | 0 | 0 | 2 | 1 | 0 | 3 |
| | | 0.0% | 0.0% | 1.4% | 0.7% | 0.0% | 2.0% |

B.H.I.P.A Position on NMR in relation to detection of Honey Adulteration



BHIPA members are in general agreement that the use of NMR may very well be an invaluable scientific tool for the assessment of honey authenticity and adulteration in the future.

It is, however, recognised that NMR assessment of honey relies critically on the quality and scope of the database of authentic samples used in the assessment-outcome determination for this technique. Several vital conditionals need to be satisfied before NMR can be used as such a tool for commercial assessment:

- Given that honey is a natural product with a wide degree of variation the database must be comprehensive, verifiable, accepted and reflective of sources of supply of genuine honey across the world.
- The markers and profiling used must be made public and the science establishing their validity and the method of analysis must all be published and reproducible by other analysts.
- Given the capability of NMR and the complex and variable nature of honey mathematical models developed and applied to aid in interpreting data must also be transparent, clearly explained and not manipulated.
- Applying such a sophisticated methodology to a complex food product such as honey should be done in an open, transparent and collaborative way so as to leave no doubt as to the conclusions drawn.

Clearly very few of these conditions have been met to date. While BHIPIA and its members recognise that NMR may well become a proven and trusted test in relation to honey in the future it must first meet these key points in relation to the database and the criteria and methods by which conclusions are drawn.

B.H.I.P.A Position on NMR in relation to detection of Honey Adulteration



In 2016 the EC JRC published a report (1) which summarised key requirements for future honey adulteration testing: -

- methods must be harmonized and fully internationally validated before legal/commercial limits can be proposed.
- an authentic & fully traceable 'biobank' of samples should be established – preferably representing as many honeys as possible traded worldwide. Gaining samples from different crop years is also very important here.
- common 'visible' reference database(s) governed and controlled by experts should be established from accumulated 'biobank' samples before any methods can be applied commercially.
- use of several complementary methods is the most likely way forward to combat honey adulteration.

The approach and conclusions of this report support BHIPIA opinion and illustrate how regulators are likely to approach adulteration testing going forward in that all tests must be shown to be fit-for-purpose, fully validated and 'transparent'/published before their use in adulteration assessment. Their substantial focus on emphasising the need for full database authentication, representation and governance is key to future work in this area.

The UK FSA recently issued updated advice to Environmental Health and Trading Standard Services (2) stating that 'the (NMR) screening method gives indicative results and does not definitively prove that added sugars are present. Our advice is that no enforcement action should be taken in relation to the NMR results alone with regards to added sugars...'

FERA also issued a recent statement (3) saying '... the use of Nuclear Magnetic Resonance Spectroscopy (NMR) tools have shown promise for the detection of exogenous sugars that may have been added to extend the volume of honey sold. However, this approach has yet to be fully validated at an international level by accredited laboratories...'

Both the FSA and FERA opinions and advice support the stance of the JRC and opinion of BHIPIA on this subject.

It is unquestionable that the NMR test has been introduced to the market in advance of its readiness and has already damaged the perception of many as to what NMR can offer to the assessment of adulteration in honey however BHIPIA and its members will continue to assess the method and explore its possibilities.

B.H.I.P.A Position on NMR in relation to detection of Honey Adulteration



Honey Protect (2018)



- Fera have agreed a project with BHIPA to construct a database of honey NMR spectra that is most relevant to the UK market
- BHIPA and Fera have agreed a sampling plan and procedure. BHIPA have taken representative samples for analysis
- Conventional honey parameters such as C4 sugars have been recorded
- NMR spectra have been recorded on samples that have all tested to be authentic using other means and for which the sample provenance is well understood

Progress to date



- 100 samples were received at Fera (2018), 80 samples in January 2019 and 100 in September 2019
- Samples and metadata have been logged in the Fera LIMS system
- Samples stored at 4 degrees C prior to analysis
- NMR spectra have been recorded from all samples received
- All QA parameters have been assessed and passed

Summary



- All analysis of 2018/19 samples has been completed
- Exploratory data analysis has been completed
- This has highlighted NMR resonances that can differentiate honey from different countries e.g. China and England
- We have highlighted resonances that are most discriminatory
- Next steps.....

Next steps



- Identify compounds that differentiate the honey by country of origin using chemical shifts and 2D NMR
- Prepare honey samples adulterated with sugar syrup and investigate how this changes the NMR spectrum
- Further investigate the influence of floral type on the composition of honey
- Continue populating the database

Acknowledgements



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INDUSTRY ISSUES



Honey is a complex natural product with a wide degree of seasonal and regional variability where beekeeping practices differ and as such honeys exhibit many unique and different characteristics. Changes in the composition of honey also occur throughout the process to packing.

There is little evidence of commercial laboratories working in collaboration with the honey industry in Europe or Asia to address potential adulteration issues.

Database and protocol as to sample collection must be comprehensive, verifiable, accepted and representative of sources of supply of genuine honey from across the world.

Contradiction exists between laboratories offering commercial NMR adulteration assessment.

Contradiction between conventional testing and NMR analysis as well as within both.

NMR assessment does not consistently and accurately identify blends – “untypical” honey once blended with “typical” honey at levels of 20% and above change the result

The use of marker compounds e.g. Mannose as determined by NMR for the identification of adulterated honey is open to challenge given the complex nature of honey, limitations of databases and lack of transparency

No explanation as to findings and interpretation. Given the assertions the application of NMR should be done in an open, transparent and collaborative way so as to leave no doubt as to the conclusions drawn

TRUST & CREDIBILITY

Give a dog a bad name

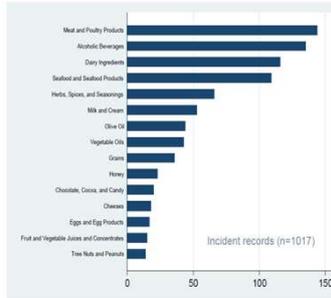
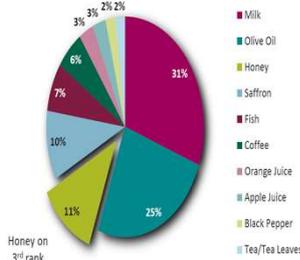


I have been passed on a presentation given by [redacted] where they quote USP's Food Fraud Database which shows honey as being 3rd at 11% in a range of foods being targeted by food fraudsters.

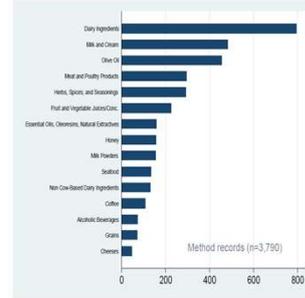
Having not seen the presentation ([redacted]), it is difficult for us to comment on their data. However, when we analyze the data in our database, honey is either 10th or 8th most "targeted." Below are screen shots from a recent presentation we gave where we looked at both Incident Records and Method Records. However, it is important to note that these records are likely a mere subset of the true occurrence of food fraud and, therefore, it is difficult to comment on the food products which are truly the most adulterated.

I would be interested to know how the detail behind this this and how it has been calculated

Main targets of adulteration according to USP's Food Fraud Database



An "incident" is a documented occurrence of food fraud in a food ingredient or product within a defined time frame. Incidents are often reported in the media and tend to include contextual and supporting information about the perpetrator, motive, geographic location, and/or other characteristics



A "method" record provides information on an analytical method for detecting food adulteration or authenticating food ingredients that has been published in a scholarly report.

Honey Authenticity - General



JRC Recommendations April 2016

- Harmonization of analytical methods
- Biobank of honeys, sgr. syrups and bee fdng. prdcts.
- European honey reference database
- Validation of emerging analytical methods



JRC Meeting Jan 2018

In summing up the following were highlighted –

- Harmonisation of methods, sample collection
- Database
- Analytical tool box well equipped i.e. can identify most forms of adulteration
- Benefit of screening tools
- Likely that there will be a need for complimentary methods
- Initiative if not led by but supported by Commission
- Include all stakeholders

Key Findings Geel 2018

- Current databases of honey NMR spectra may not be representative of international market sources
- Databases should take into account variation due to seasonality and permitted practises such as blending
- Potential for unexpected overlapping resonances at lower field strengths and impact on quantification not fully explored
- Some key markers used to imply adulteration have not been identified/ disclosed so cannot be validated
- NMR analysis results for immature honeys and blends seem to be most problematic due to confusion about permitted practises



General Recommendations

- Validate methods of analysis for honey, particularly NMR, LC-IRMS and DNA based pollen tests
- Database QA is critical for implementing a successful honey monitoring programme
 - Criteria for stating that a honey is adulterated need to be more transparent
 - Improve understanding of honey production within and particularly outside of the EU
 - Unify approach internationally as similar work is being undertaken particularly in US but also China and NZ

Honey Authenticity - General



CDG Animal Products – Beekeeping sector, Bruxelles, BE– 17/05/2019

- Release of the Food Authenticity Knowledge Base.
- Operate a 2nd Inter-laboratory comparison exercise on LC-IRMS and publish a Standard Operating Procedure.
- Collect authentic honeys, bee feeding products, syrups and full traceable blends.
- Continue testing the metabolomics approach (profiling and fingerprinting) by Nuclear Magnetic Resonance, LC-HRMS and HPAE-PAD, and the metabarcoding.
- Technical meeting with competent authorities of the Member States on data sharing and design of compositional databases.



UK Committee on Bee Products – AW/34/19 formed to provide UK input into ISO/TC34/SC19 <https://www.iso.org/committee/6716626.html>

Committee comprised of FSA, DEFRA, FERA, NBU, BHIPA



Conclusions



- NMR has significant potential in conjunction with other methods and B.H.I.P.A. will continue to assess via “Honey Protect” project
- Introduction, in our opinion, was commercially driven not fit for purpose and has alienated the industry
- NMR database composition and integrity is critical for accurate and consistent interpretation of findings
- Lack of collaboration, transparency, validation, verification etc.
- Traceability, knowledge and appropriate controls within the supply chain cannot be overlooked

It is unquestionable that the NMR test has been introduced to the market in advance of its readiness BHIPA and its members will continue to assess the method and explore its possibilities.