

POSITION PAPER

EBA's proposal on Enzymatic Activity, Pollen Content and Traceability

EBA's proposal on HMF content and Enzymatic activity

At the 2nd meeting of the Honey Platform, the European Beekeeping Association (EBA) stated that the current use of HMF content and diastase activity as indicators for detecting honey overheating must be revised and supplemented with additional provisions.

To ensure that honey quality standards reflect scientific evidence and modern fraud detecting techniques, the EBA recommends:

- amending current HMF and diastase criteria to account for honeys with naturally low enzymatic activity;
- providing an official EU-wide list of monofloral honeys with documented low diastase levels.
- clarifying the legal interpretation of the phrase “after processing and blending” to protect producers from post-processing degradation penalties;
- legislating detection methods for enzyme adulteration and HMF removal;
- considering invertase as an alternative quality parameter only after thorough standardization and validation through a structured pilot phase.

This article aims to further explain and support the EBA's position, helping the chair and the committee to better understand our concerns and recommendations.

A. THE HMF AND DIASTASE CRITERIA SHOULD BE AMENDED

The current criteria must be revised in the following three areas:

a) Reconsidering the Correlation Between Enzyme Activity and HMF in Honeys with Naturally Low Enzymatic Activity

Both Codex Alimentarius and the European Honey Directive acknowledge that some types of honey naturally have low enzymatic activity. The Directive cites citrus honey as an example, permitting a diastase activity as low as 3 DN, provided that HMF does not exceed 15 mg/kg.

However, this provision is problematic and not in accordance with the latest scientific evidence. In honeys with naturally low-enzymatic activity, fresh and unprocessed samples may already contain 12–13 mg/kg of HMF. Minor processing or blending can easily push the HMF level beyond 15 mg/kg. Additionally, the use

of oxalic acid to control Varroa mites—a common practice among European beekeepers—can also elevate HMF beyond the legal threshold.

Figure 1 illustrates HMF and diastase enzymatic activity values, expressed as DN values, in 61 citrus honey samples collected directly from colonies and analyzed fresh and unprocessed. While the first 15 samples show zero HMF with low diastase activity (thus fully marketable), the last 7 samples (No. 54–61) have HMF levels above 10 mg/kg. Minor processing could easily bring them above the legal 15 mg/kg limit, resulting in 11.5% of authentic, unprocessed citrus honey being ineligible for market placement.

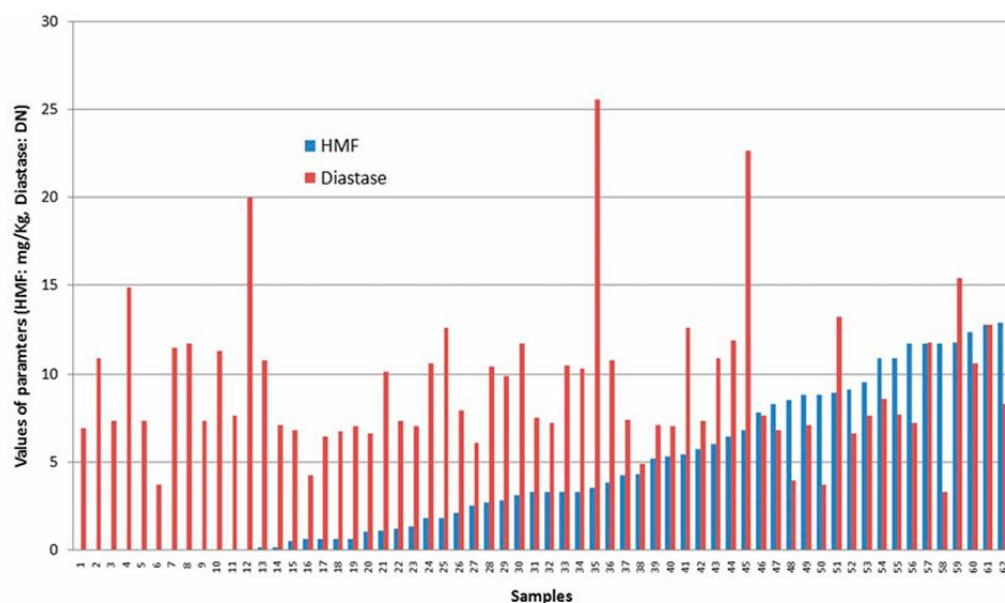


Figure 1. HMF and diastase activity of fresh unprocessed samples of citrus honey (Thrasyvoulou et al., 2018).

Unlike the Directive, Codex does not tie diastase levels to HMF concentrations, nor does it single out citrus honey. This is reasonable, as there are many other honeys with naturally low enzymatic activity levels, like manuka (*Leptospermum* spp.), black locust (*Robinia pseudoacacia* L.), rosemary (*Rosmarinus officinalis* L.), heather (*Erica* spp.), dandelion (*Taraxacum* spp.), strawberry tree (*Arbutus* spp.), and pine honey, which should be acknowledged by control authorities.

Countries such as Brazil, Canada, Russia, Turkey, and Serbia accept any honey with diastase levels above 3 DN, provided that HMF is below 15 mg/kg.

EBA recommends disconnecting the diastase activity requirement from HMF content for honeys with naturally low enzymatic activity levels. These honeys should be recognized as such, without being subject to additional quality constraints. This approach aligns with the principles of Codex Alimentarius.

b) Including a List of Honeys with Naturally Low Enzymatic activity in the Directive

Control authorities are often not specialists in honey and may not know which types naturally exhibit low enzyme activity. Any honey that does not originate from citrus and shows diastase activity below 8 DN is often deemed non-compliant, removed from the market, and subject to fines—regardless of authenticity.

EBA recommends that each Member State compile and provide an official list of monofloral honeys that are naturally low in diastase activity. This list should be incorporated into the Directive, similar to existing exceptions for sucrose and water content, to prevent unjust penalties against producers and packers.

A harmonized template for such national lists could include: botanical source, typical diastase activity range (DN), geographical zones of occurrence, and citation of published data or national studies. This list should be dynamically updated based on emerging research and monitored jointly by national food authorities and apicultural experts.

c) Clarifying the Meaning of “After” in “Determined After Processing and Blending”

Diastase activity and HMF content are critical criteria used to evaluate honey quality, heat treatment, and potential adulteration. These “freshness” parameters are sensitive to both heating and storage conditions.

Annex II, paragraph 6 of the European Directive states that diastase activity and HMF content must be “determined after processing and blending.” However, this phrasing is ambiguous and can be interpreted in two ways:

- **Interpretation 1:** The producer analyzes the honey immediately after processing and labeling in an accredited laboratory and keeps the results linked to the batch number. Official inspections rely on these original test results. In this case, the producer is not liable for quality changes due to prolonged storage or inappropriate storage conditions on the market. If HMF exceeds 40 mg/kg or diastase falls below the legal threshold later, the producer simply replaces the product without penalties.
- **Interpretation 2:** The control authority may analyze honey at any time post-processing, even after prolonged shelf storage. In this case, the producer is held responsible for any degradation in quality—even if it occurred naturally during storage.

EBA recommends that the phrase “after processing and blending” be clarified in legislation to avoid misinterpretation and unfair sanctions. Legislative language must be unambiguous and consistent. EBA proposes that the phrase “after processing and blending” be replaced with:

“Immediately following processing and prior to retail packaging, as documented by a traceable batch analysis conducted in an accredited laboratory. Test results from this phase shall serve as the definitive reference for product conformity, and legally compliant storage thereafter shall not be grounds for penalization.”

B. THE HMF AND DIASTASE CRITERIA SHOULD BE SUPPLEMENTED

a) Legislate a Method for Detecting Added Fungal Diastase

Overheated honey can be fraudulently “restored” by adding fungal enzymes to artificially increase the diastase number. Commercial alpha- and beta-amylases—primarily derived from *Aspergillus oryzae* or *Rhizopus* spp.—can be mixed into honey under mild heating to raise the enzyme level just above the legal threshold.

Detection of exogenous enzymes is possible using advanced techniques such as Isoenzyme profiling (e.g., isoelectric focusing, electrophoresis), Enzyme activity ratio (diastase/invertase), Mass spectrometry (MS), Immunodetection (e.g., ELISA for fungal proteins) and other methods.

These methods must be officially legislated for them to be admissible in legal proceedings.

b) Legislate a Method for Detecting HMF Removal via Resin Filters

HMF is a key indicator of honey overheating. However, adulterators can now remove excess HMF using resin filtration systems, which are advertised online by certain suppliers (especially in China) (Fig 2). These filters also remove antibiotics, chemical residues, and pollen.

The removal of pollen impairs the ability to trace geographical origin. Even small additions of local honey to ultra-filtered blends can create the illusion of “local origin.” For instance, mixing just 20 kg of local honey into a 1-ton blend can produce 1,000 pollen grains per 10 g of honey—technically enough to appear authentic under current EU guidelines, which set no minimum threshold for pollen content. While filtered honeys are no longer permitted in the EU, such products are now often labeled as “baker’s honey,” which can be used in similar ways.

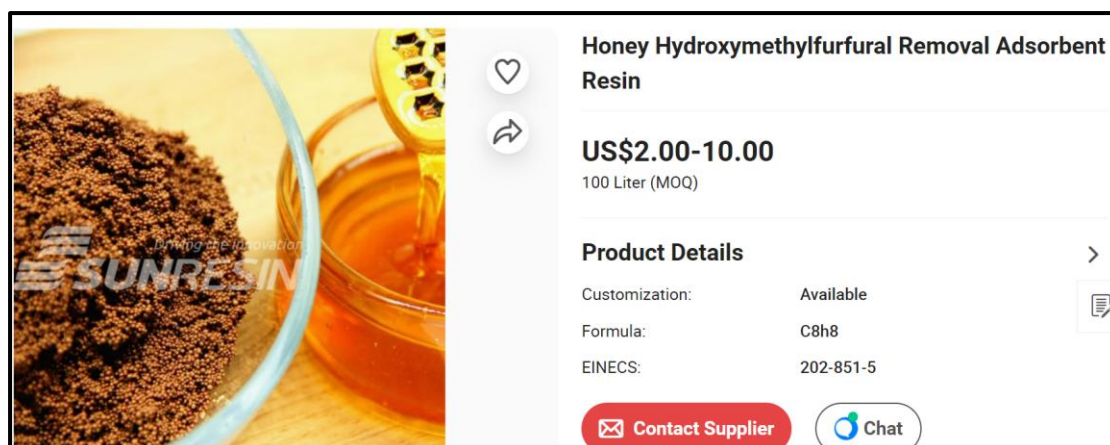


Figure 2. The removal of HMF from honey is now widespread and much advertised.

Detecting artificial HMF removal is challenging, but not impossible. Potential methods include Isotope Ratio Mass Spectrometry (IRMS), HPLC/GC-MS, FTIR/NIR with Principal Component Analysis (PCA), Nuclear Magnetic Resonance (NMR), Detection of resin residues (leachables) and other methods

EBA believes that unless methods to detect both enzyme addition and HMF removal are legislated, the integrity of honey overheating controls cannot be guaranteed.

c) Replacing HMF and Diastase with Invertase?

If the European Commission decides not to amend the HMF and diastase criteria or introduce supporting legislation to detect adulteration, EBA is open to considering invertase as a replacement—but only under specific conditions.

Invertase could replace HMF and diastase as a quality control criterion if:

- Member States are given time to analyze a large number of monofloral honeys to determine natural enzyme variability;
- Honeys with naturally low enzymatic activity are listed and exempted from threshold limits, similar to our recommendations for diastase;
- Enzymatic activity is measured immediately after processing. Packers should not be penalized for post-processing degradation;
- A validated method is legislated to differentiate between natural (bee-derived) and industrial (added) invertase.

EBA proposes a structured pilot phase for invertase adoption. During this phase, Member States would analyze a representative number of monofloral honeys ($n \geq 100$ per country) to define baseline invertase levels. Only after cross-comparison and standardization could invertase be considered a robust replacement for HMF and diastase. Until then, its use should be restricted to research and supportive documentation.

The addition of prerequisites for the acceptance of invertase as a criterion for identifying overheated honey, comes from the following considerations:

- Natural invertase levels in monofloral honeys are not well established;
- Invertase levels vary significantly within the same honey type, depending on factors like bee health, climate, nectar flow, season, and hive conditions;
- Some honeys have low invertase, others moderate, and some very high—making standard thresholds unreliable;
- Invertase is highly sensitive to storage. Its activity declines rapidly over time, limiting shelf life;
- Industrial invertase, such as β -fructofuranosidase used in bee feeding syrups, can contaminate honey. There is also a risk of direct addition of non-bee invertase—paralleling concerns about added diastase.

Conclusion

The EBA strongly recommends that the criteria for HMF content and diastase activity be amended, clarified, and supplemented with enforceable legislation to detect fraudulent practices. If invertase is to be considered as an alternative criterion, a structured approach is necessary and essential to ensure its effective, fair, and scientifically sound implementation.

EBA's Proposal on Traceability and Honey Pollen Content

We welcome the amendment to the Honey Directive requiring labelling of origin and percentages in honey blends. For transparency, an effective traceability system must support this. Current rules on pollen content and food traceability do not sufficiently ensure geographic origin or trace honey from producer/importer to consumer. A robust regulatory framework is urgently needed to protect authenticity, traceability, and safety in the EU honey market.

A. HONEY POLLEN CONTENT

The gold standard for pollen analysis is a melissopalynology analysis using light microscopy. AI-assisted methods and DNA barcoding are promising but require validated reference libraries of pollen from 100% authentic honeys—available only from beekeepers, not processors.

The Directive permits only coarse filtration, not ultrafiltration, which requires pressure and heat, damaging the honey. Revised definitions under Directive 2024/1438 now allow extensively filtered products under "baker's honey"—a concern since pollen is the primary natural indicator of geographic and botanical origin. Removing it eliminates the forensic traceability of the product. We urge the

EU to clarify “filtration” and “foreign matter” definitions, suggesting the latter include only large visible particles (e.g., bee parts, wax lumps, plant fibers).

a) Minimum pollen content

Minimum pollen levels must be sufficient to enable determination of geographic and botanical origin. As pollen content varies by botanical origin, processing methods, climate, soil, and beekeeping practices, exceptions should exist for monofloral honeys with naturally low pollen content.

b) Minimal mesh size of filters

Pollen grains in honey vary in size depending on their botanical origin, typically ranging from 5 µm to 150 µm in diameter. Pollen grains larger than 100 µm are relatively rare but can be good indicators of the tropical or subtropical origin of honey. Coarse filtration/straining with mesh size >200 µm preserves the honey pollen spectra. Baker’s honey could be filtered using a mesh size >100 µm, allowing the removal of only the largest pollen grains.

We summarise our proposals for definitions of filtration and categorization of the honey after filtration in the table below.

Filtration and mesh size	Name of the product
Ultrafiltration, <10 µm	Should NOT be called “honey”!
Fine filtration, 10-99 µm	Should NOT be called “honey”!
Filtration, 100-199 µm	“Baker’s honey”
Coarse filtration / straining, >200 µm	“Honey”

EBA proposes that melissopalynology experts from each country define thresholds for monofloral honeys and list monofloral honeys with naturally low pollen content to be treated as exceptions. EBA recommends minimal mesh size 200 µm and banning filtration using filters with mesh size <100 µm, as it changes the pollen spectrum to a level where determination of botanical and geographical origin is not possible anymore. Such products should not use the name “honey”. Filters with mesh size between 100 µm and 199 µm could be permitted only for baker’s honey.

B. TRACEABILITY

A comprehensive system should combine stricter border controls, digital platforms, and administrative oversight.

a) Stricter Border Controls

All honey imports must pass through approved Border Control Posts (BCPs), as per Regulation (EU) 2017/625. These should be equipped with labs and trained personnel. With honey among the most adulterated foods globally, limiting entry to certified BCPs is justified. We support heightened checks—especially for high-risk countries—detaining consignments pending results and conducting secondary sampling at delivery sites.

b) Digital Traceability Systems

Paper systems are inadequate for complex global supply chains, especially when honey is blended post-import. We propose a **mandatory EU-wide digital traceability framework**. Each member state should maintain a national *Honey Inventory Balance*, recording inflows/outflows of honey at every stage of storage and distribution. These should integrate with BCPs, national beekeeper registries (with annual hive declarations), and the TRACES system.

Though TRACES certifies imported honey, its references are not currently tracked through the supply chain. We recommend **mandating honey batch-level linkage of TRACES certificates** throughout processing, blending, analysing, packaging, and distribution, ensuring immediate backward traceability to the importer. Each country should appoint a **national reference laboratory** to maintain a database of imported honey samples and support a **pollen atlas**. Labs should collaborate EU-wide, sharing data and conducting interlaboratory comparisons. Mandatory tests should include pollen analysis and testing for adulteration with exogenous sugars and enzymes.

Traceability gaps persist within the EU. Once honey enters the single market, repackaging, blending, or re-export often lacks transparency. A registry of bottlers/traders—covering both domestic and imported honey—is essential. Bottlers should declare origin percentages and total volumes per batch, enabling better stock tracking and post-mixing traceability. Sampling and testing of intra-EU shipments should be routine, with data submitted to national reference laboratories and the pollen atlas. Member states should issue interim national regulations, as done in Germany, France, and Greece.

We recommend blockchain technology for traceability, assigning each batch a unique code (QR, barcode, or RFID) linked to full origin and processing history. With a blockchain-based system the entire journey of honey can be tracked and verified—from the apiary to distribution centres, and finally, to store shelves. Each entry is immutable, meaning it cannot be altered or deleted once added to the blockchain. Blockchain's immutability ensures **data integrity, transparency, and accountability**. Moreover, a part of the database could be made public for consumers to scan the identifier on the honey label and easily reach relevant data, e.g. its origin and relevant laboratory test results. This would significantly boost consumer confidence and traceability assurance.

c) Strict Administrative Controls

Full documentation (invoices, certificates, transport records) must accompany all intra-EU shipments. TRACES references should be retained for at least five years. Controls must verify that supplier invoices match declared stock records and batch quantities.

EBA recommends integrating current regulatory tools (TRACES, digital beekeepers registries) with modern digital systems. In summary, our proposal includes:

- establishment of Honey Inventory Balance system;
- integration of TRACES data;
- integration with national digital beekeeper registries;
- enforcement of Regulation (EU) 2017/625;
- designation of reference laboratories, responsible for database and pollen atlas of imported honey;
- traceability system also for honey traded within Europe;
- declaration of mixing percentages and batch quantities;
- adoption of digital traceability systems across EU.

To implement traceability requirements effectively and affordably, we propose a blockchain-based traceability system and unique identification for each batch. Prior to mandatory implementation, the EU should explore regulatory sandboxes to test, refine and standardize these tools.

Members of the EBA's Scientific Committee on Safety and Quality of Bee Products

References

Andreas Thrasyvoulou, Chrysoula Tananaki, Georgios Goras, Emmanuel Karazafiris, Maria Dimou, Vasilis Liolios, Dimitris Kanelis & Sofia Gounari (2018) Legislation of honey criteria and standards, J. Apic. Res. 57:1, 88-96, DOI: 10.1080/00218839.2017.141118