CSE Investigation
Business of Adulteration of Honey

Media release
Dec 02, 2020
Why this investigation?

- We were **alerted** that beekeepers from North India (and other parts) were in deep distress
  - **Business** had turned **unprofitable**
  - **Prices** of raw honey had **crashed** like never before

- But why? We asked. After all,
  - **Sale of honey is booming** due to the threat of **Covid-19**
  - The Union government has a **massive programme** for beekeepers—some **Rs 500 crore** is being spent to build their livelihoods
We travelled; got some clues...

- **Heard a grim story repetitively from beekeepers**
  - Were getting good rates till 2014-15; then prices started to fall
  - From Rs 150 per kg to Rs 60-70 per kg

- **Small and large traders confirmed the price crash, but were less open about reasons**
  - One mentioned: “*We have heard that honey is mixed with sugar syrup, and this syrup made from rice and other crops can pass all laboratory tests. Companies are mixing this sugar syrup with a little honey and making huge profits.*”
  - Other divulged that he heard **Chinese companies** had come with their technology and had set up factories in Jaspur in Uttarakhand, Dhampur in Bijnor, UP, and Batala in Punjab; Another from Rampur confirmed this

- **There was something going on; but what?**
  - These businesses, even if tracked down would say they were producing sugar syrup for selling to confectionary and other industries. **Legitimate businesses!**
Part 1

Adulteration business

The business of adulteration is devious and evolving
Honey is the most adulterated food in the world.

The globally accepted definition of honey by the Food and Agriculture Organization’s (FAO’s) Codex Alimentarius Commission is:

“(it) is the natural sweet substance produced by honeybees from the nectar of plants or from the secretions of living parts of the plants or excretions of plant sucking insects on the living parts of the plants, that bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honey comb to ripen and mature”.

If honey is adulterated with sugar it is not honey.
Globally, the first test added was for C4 sugar syrups
- From plants like corn and sugarcane (C4 photosynthetic pathway); this could then be detected by lab

So adulteration business evolved to beat laboratory tests
- Sugar from another category of plants used - rice or beetroot (C3 photosynthetic pathway)

Laboratories came up with:
- Isotope tests to detect adulteration (C4 first and then C3 sugars)
- Special Marker for Rice Syrup (SMR) and Trace Marker for Rice Syrup (TMR) – for rice syrup (C3)
- Foreign oligosaccharides – to detect starch-based sugars, like rice syrup (C3) and corn (C4)

So now the game is to beat the tests that can detect C3/C4 by adding a modified sugar syrup that can bypass and go undetected
Honey fraud is a big concern across the world.

**HONEYGATE**

The adulteration of honey is a global phenomenon—it's trail goes everywhere. Countries are struggling to stay ahead of the evil designs of companies who are engaged in the ever-evolving business of honey fraud.

**Canada**
The Canadian Food Inspection Agency launched an enhanced honey authentication surveillance in 2018-2019. **240 samples were collected** and analyzed using both the Isotope Ratio Analysis and NMR. It found some 27 percent of the samples—imported honey brands—unsatisfactory on one or the other test. Based on this, the agency claimed inspection had stopped close to 13,000 kg of adulterated honey from entering the country.

**USA**
The world's biggest honey market—it produces much below what it consumes—and so exporters line up to sell here. In 2017, domestic production only met 25 percent of total US honey consumption. In 2009-2010, it was found that Chinese exporters were transshiping their products through other countries, including India, to hide the origin of honey. The food scandal called honey-laundering was busted. More recently there is concern about quality and adulteration of imported honey. In May 2020, the US House Committee on Homeland Security directed the Customs and Border Protection Agency to use the best technology available, include the purchase and use of NMR equipment, and also to develop a comparison database of honey.

**Europe**

The European Union

In 2015, the European Commission started a coordinated monitoring plan to study the prevalence of adulterated honeys in the European market (2,264 samples). In this study, roughly 40 percent of the samples (893), which were compliant with standards were sent for further examinations with LC-IRMS, a method that couples high-performance liquid chromatography with isotope ratio mass spectrometry. Analysis showed “foreign” sugar had been added in roughly 20 percent of the sample tested and that these sugars had remained undetected in the previous tests. It recommended that not only should a European honey reference database be created but also complementary tests should be used for analyzing quality and integrity of honey.

**Australia and New Zealand**

In October 2018, scientists at Macquarie University tested 100 samples of honey—Australian and from other countries—which they bought from local supermarkets. One in five samples were found to be adulterated—mainly with sugar syrups—including domestic honey. The study pointed out that the country only tests 5 percent of the samples and only those that are imported and only for C4 sugar. This came just after another scandal had broken out that involved Australia's largest honey brand—Capilano—when it was found that of the 298 samples of manuka blossom honey that were tested, 40 percent were found to be adulterated. The tests were done in Germany using NMR technology for detection of sugar syrup in the honey. Capilano denied any wrongdoing; attacking the tests. However, there was widespread support for the need for new testing methods, like NMR and it was revealed that the Australian Bee Industry Council (which includes Capilano) had written to the government asking for NMR tests to be introduced. Other brands accused of selling fake honey withdrew their bottles from the shelves. In New Zealand, NMR is increasingly becoming popular because of export of their high-value honey to EU customers. It is also being used to detect false C4 test positives such as in case of Manuka honey.
Changing standards; issuing directions: something is afoot

2010: CSE lab found antibiotic residues in honey
2014: FSSAI amends honey standards to include antibiotic residue limits
2017: FSSAI drafts standards for honey, which includes tests to detect cane and rice sugar (C3 and C4 sugars)
2018: FSSAI notifies standards with some minor changes
2019: FSSAI reverses decision to test key parameters such as SMR, TMR and Foreign oligosaccharides that would have allowed detection of rice sugar and other adulteration in honey
December 2019 & June 2020: FSSAI informs state food commissioners that sugar syrups are being used for adulteration. Asks for regular inspections
February 2020: Ministry of Commerce makes it mandatory for honey exports to be screened using NMR technology to detect sugar syrups. EIC (Export Inspection Council) sets up laboratory for this check
May 2020: FSSAI says it has been informed about adulteration of honey using golden syrup, invert sugar syrup and rice syrup. It asks importers to register with it and to inform of the usage of imported products
July 2020: FSSAI reinstates key parameters, but not one additional test TMR to detect rice syrup. Issues 2020 Standard.
In India FSSAI Standards for honey purity have been revised again and again.

One major change in the latest July 2020 notification: TMR excluded.
In India, government knows (but is not telling) that something is seriously wrong

- The government (Ministry of Commerce and Industry) has mandated additional advanced tests for honey (NMR) that will be exported
  - It shows that government suspects or knows that Indian honey has some adulteration, but is not being detected using tests for C3 and C4 sugars
- We filed an application under the Right To Information Act (RTI) with the Imports Division of FSSAI
  - Asked for information received from industry and to understand what further steps are being taken to check the source of adulteration by imported sugar syrup
  - FSSAI has said it has sent the RTI application to another division, but has not cared to say which one
- So, either FSSAI knows what is going on, and is not telling us—the consumers—**or, it is fishing around** to see if it can find the honey fraud and stop it
Part 2

Leads to China

Tracking down the imported syrup being used for honey adulteration

The question was: what is this syrup? Who makes it? Where does it come from?
Clues but dead-end

• FSSAI directive on import of golden syrup, invert sugar syrup and rice syrup used for adulteration is a dead end
• But we find Chinese trade portals like Alibaba advertising fructose syrup that can bypass tests C3 and C4
• Same Chinese companies that advertise this fructose syrup that can beat C3 and C4 tests also export to India
Chinese companies are in the lead

Chinese trade portals like Alibaba advertise fructose syrup that can bypass tests.
In the export import database of the Union Ministry of Commerce and Industry, two of the FSSAI named syrups — rice syrup and golden syrup — could not be found (no separate HS codes)

“Invert sugar”, the third one – had an HS code but limited shipments

Repeated use of the terms fructose and glucose on Chinese websites prompted us to look at the imports of these from China

**We found:**

- China is driving the trend of fructose syrup and glucose quantity imported in India
- The average quantity of fructose is over 10,000 MT every year since 2014-15
From a trade base, we found:

- In the last four years, more than 11,000 MT of fructose syrup had come from these sellers (~70 per cent of the total from China) as ‘industrial raw material’
- Buyers were from Punjab (Faridkot, Patiala and Rajpura); Delhi NCR; Jaspur and Kashipur (Uttarakhand).

On the face of it, these companies appear to be the legitimate syrup or honey suppliers (don’t mention about passing adulteration tests on their websites)
Part 3

How we broke honeygate

An undercover operation to contact Chinese sellers of sugar syrup brought to light the shady business
- We sent emails to Chinese companies soliciting syrups that could pass tests in India
- These are the same Chinese companies that export fructose syrup to India
- Replies received that syrups are available and can be sent to India
- Chinese companies inform us that even if 50-80 per cent of the honey is adulterated with syrup it would pass all stipulated tests
- Chinese company export syrup as paint pigment
- Company routes sample through Hong Kong to bypass custom clearance
The China trail
A record of our correspondence in soliciting syrups that can pass Indian testing protocols.

September 21, 2020
We wrote to two Chinese companies—Wuhu Deli Foods Co. Ltd and CNNFoods—both based in An Hui Province, asking for syrup/vice syrup that could pass Indian honey testing protocols.

September 22
Wuhu Deli replied their product met our requirements and specified the rates for F48 and F55. The company also wanted to know which Indian port it would ship the produce.

September 24, 2020
The other company—CNNFoods—replied saying they could supply us fructose syrup of any fructose glucose ratio (FG).

October 22
We received the samples.

October 23
We sent the commercial invoice and material data safety sheet of the samples. Instead of honey or syrup, the samples had been shipped as Plastic Pigment Emulsion.

October 30
Wuhu Deli sent us the samples through FedEx. We received the invoice. We informed Fed EX that we needed a clearing agent to clear the samples at our end as it had come as cargo. We asked Fed EX to cancel the shipment.

October 20
CNNFoods sent us the commercial invoice and material data safety sheet of the samples. Instead of honey or syrup, the samples had been shipped as Plastic Pigment Emulsion.
Part 4

Indian passage for adulteration

Manufacturing of adulterant syrups has begun closer home
We hear that Chinese companies have sold technology for bypass syrup to India

We track down factory that manufactures syrup to adulterate honey to Jaspur in Uttarakhand

We learn that that the code word is "all pass" syrup

We make contact and procure a sample of this "all pass syrup"

It will pass all stipulated tests for honey purity says the owner
Part 5
When we spiked honey with Chinese and Indian 'all-pass' syrups

If the samples passed the tests for purity, it would show that such syrups worked
We spiked honey with Chinese and Indian all-pass syrups

- We adulterated samples of pure honey
- Mixed Chinese and Indian all pass syrups at 25%, 50% and 75%
- Sent samples to laboratory
  - Same Indian laboratory (CALF of NDDB) where honey samples were tested for key adulteration parameters set by FSSAI
- Adulterated samples with 25% and 50% sugar syrup passed the test of purity
- We confirm that sugar syrups exist that can bypass the 2020 FSSAI standard for honey
Raw honey sourced directly from a beekeeper in Bharatpur from the nectar of ber plant sucked up by bees in Jaisalmer.

Scientists from CSE’s Environmental Monitoring Lab “mixed” the syrup and honey using scientific tools and procedures.

75% spiked sample failed; it was clear others passed because the adulterant could not be detected.
Part 6
Laboratory tests of honey we consume
13 top and smaller honey brands were selected; samples sent to Indian and German lab

<table>
<thead>
<tr>
<th>Samples</th>
<th>Lab</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8 processed honey</strong></td>
<td>CALF, NDDB*</td>
<td>Adulteration, quality (FSSAI 2020)</td>
</tr>
<tr>
<td><strong>5 samples</strong></td>
<td>CALF, NDDB</td>
<td>Adulteration, quality (FSSAI 2020)</td>
</tr>
<tr>
<td>(4 raw+1 processed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>13 samples</strong> (same batch)</td>
<td>German lab^</td>
<td>Advanced testing: NMR profiling, TMR</td>
</tr>
<tr>
<td><strong>4 samples</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2 each of different batch of 2 brands)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5 samples</strong> of major brands</td>
<td>German lab</td>
<td>Advanced testing: NMR profiling, TMR</td>
</tr>
<tr>
<td>(for reconfirmation – which failed on NMR in the first round)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Centre for Analysis and Learning in Livestock and Food, National Dairy Development Board, Gujarat, India; ^ A renowned food testing laboratory in Germany; samples sent through Indian counterpart; name not disclosed as per the agreement with lab; if required all details could be shared with government agencies; Export Inspection Council (EIC) near Mumbai that had the equipment to test for NMR was not open for us to send samples.
Laboratory tests

• We select 13 top and smaller honey brands
• We first send samples of 8 top brands to NDDB state of the art laboratory for tests (August 2020)
• All honey tested passed the laboratory tests for Indian standards (except Apis Himalaya). Laboratory does not find adulteration of C3 and C4 sugar in these brands
• We then bought five smaller brands and sent to same laboratory
• Most of the smaller brands fail the laboratory tests for Indian standards
• Adulterated with C4 sugar in most cases
Incomplete story

• By then we had tracked down the modified syrups; we knew there was more to this story
• We then sent samples are sent to top laboratory in Germany
• And the picture changes
• Many passed samples fail on Trace Marker for Rice (TMR)
• Almost all samples fail on NMR. Laboratory says indicates adulterated/addition of sugar syrup
**What is NMR?**

- NMR is seen as the **gold-standard** for testing for adulteration in honey
  - Think of NMR as the difference between X-ray and blood test and **Magnetic Resonance Imaging (MRI)**
  - The technology uses imaging to get a full picture of the honey and its constituents
  - Identifies the **origin** of the honey and its **authenticity**

- Developed by a German company and **now governments** are using it to **check origin** and **adulteration** in honey
  - It is also clear that very soon **even this technology will get obsolete** as the adulteration business will find new ways
- Samples sourced from retail stores from Delhi and major online stores b/w Aug-Nov 2020
- Overall 22 samples sent to the German lab for advanced testing
- Two additional samples each of Dabur and Saffola also sent (different batches); they advertise their products are NMR tested

### Honey is adulterated

Advanced tests which can detect modified sugar syrups confirm this

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>Brand</th>
<th>Tests from Indian lab</th>
<th>Tests from German lab</th>
<th>Interpretation as provided by the German lab</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C4</td>
<td>Δδ13C p-h</td>
<td>Δδ13C Fru – Glu</td>
</tr>
<tr>
<td>FSSAI specification</td>
<td>Max. %</td>
<td>≥</td>
<td>±</td>
<td>±</td>
</tr>
<tr>
<td>1</td>
<td>Dabur Honey</td>
<td>Pass 0.0</td>
<td>Pass 0.1</td>
<td>Pass (&gt;0.1)</td>
</tr>
<tr>
<td>1A</td>
<td>Dabur Honey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1B</td>
<td>Dabur Honey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Patanjali Honey</td>
<td>Pass 0.0</td>
<td>Pass 0.3</td>
<td>Pass (&gt;0.9)</td>
</tr>
<tr>
<td>2A</td>
<td>Patanjali Honey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Apis-Himalaya Honey</td>
<td>Pass 4.6</td>
<td>Pass (&gt;0.9)</td>
<td>Pass 0.1</td>
</tr>
<tr>
<td>4</td>
<td>Baidyanath Honey</td>
<td>Pass 4.6</td>
<td>Pass (&gt;0.8)</td>
<td>Pass 0.2</td>
</tr>
<tr>
<td>4A</td>
<td>Baidyanath Honey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Zandu Pure Honey</td>
<td>Pass 2.7</td>
<td>Pass (&gt;0.5)</td>
<td>Pass 0.0</td>
</tr>
<tr>
<td>5A</td>
<td>Zandu Pure Honey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Nature's Nectar Honey</td>
<td>Pass 5.4</td>
<td>Pass (&gt;0.9)</td>
<td>Pass (&gt;0.2)</td>
</tr>
<tr>
<td>6A</td>
<td>Nature's Nectar Honey</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

TMR: Unauthorized addition of rice syrup was detected
NMR: Indicates adulteration/addition of sugar syrup

*Absent indicates not detected
- If a sample fails on any of the parameters, then it fails the adulteration test.

- **Isotope testing:**
  - for C4/C3 sugars
  - SMR-TMR: for rice syrup
  - Foreign oligosaccharides: for starch-based sugars — e.g. rice (C3), corn (C4)
  - NMR: advanced testing for modified syrups

<table>
<thead>
<tr>
<th>Lab</th>
<th>Tests from Indian lab</th>
<th>Tests from German lab</th>
<th>Interpretation as provided by the German lab</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>FSSAI specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Max. %</td>
<td>±1.0</td>
<td>±2.1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>07</td>
<td>13k</td>
<td>1.0</td>
<td>0.2</td>
</tr>
<tr>
<td>08</td>
<td>13k</td>
<td>1.8</td>
<td>0.3</td>
</tr>
<tr>
<td>08A</td>
<td>13k</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>08B</td>
<td>13k</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>09</td>
<td>13k</td>
<td>5.2</td>
<td>0.8</td>
</tr>
<tr>
<td>10</td>
<td>13k</td>
<td>20.2</td>
<td>-3.4</td>
</tr>
<tr>
<td>11</td>
<td>13k</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>11A</td>
<td>13k</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>13k</td>
<td>26.6</td>
<td>-3.8</td>
</tr>
<tr>
<td>13</td>
<td>13k</td>
<td>8.1</td>
<td>-1.3</td>
</tr>
</tbody>
</table>

*Note:* *Indicates samples not tested for this parameter. ND—Not Detected

- **Column (1):** Quantifies C4 sugars
- **Column (2) to (4):** By applying EA/LC-IRMS for the determination of the —13C, adulteration with both C4 and C3 sugars could be detected.
- **Column (5):** Foreign oligosaccharides are starch-based sugars such as from rice, corn, and wheat—corn is both C4 and C3 sugars
- **Column (6) and (7):** These are markers for rice syrup, thus identify C3 sugars
- **Column (8):** NMR shows addition of sugar syrup — could be either C4 or C3 plant based

For test report visit website www.cseindia.org
What has emerged

- **Three brands out of 13 brands**, namely Saffola, Markfed Sohna and Nature’s Nectar (one sample), passed all tests, including NMR
- **Out of the 22 samples only five bottles passed NMR**—77 per cent of the samples failed the NMR test
- **Three brands, Dadev, Hi Honey and Societe Naturelle**, failed C4 sugar syrup tests indicating that their adulteration was “**basic**” and not with the use of modified sugar syrup.
What do we conclude?

- That much of the honey we consume is adulterated
- The business of adulteration is sophisticated and evolved. It uses sugar syrups that are “modified”
- The syrups are imported from China and are now also manufactured in India. Up to 50 per cent adulteration is certainly possible
- Economics works in favour of the adulterant
  - Rs 60 per kg of syrup vs Rs 120 per kg for raw honey for beekeeper
  - Easier to buy syrup in bulk than work on beekeepers supply chain
- The big-brand honey Indians are consuming has already caught up with the modified sugar syrup business; pass standards set by FSSAI
- The NMR technique is the only way to check for this modified syrup
  - But very soon there will be another adulterant in the market—this time it will even pass the NMR test
- Need to understand the impact on our health of this sugar-laden honey
Part 7

Immunity booster or buster?

What makes honey special and why honey adulterated with sugar is bad
The big question for us, the consumers...

- Does it make a difference if the honey we are consuming is actually sugar?
- What are the honey’s special properties that differentiate it from sugar? What will it do to our health if we have sugar, instead of honey?
- Does it have implications, particularly in this time of covid-19?
Bad for our health; COVID-19 will be made worse

- **Honey is sugar but a special one, full of nature’s goodness**
  - “sugar” of honey is transformed to goodness; honey is then not about the “sugar”, but the enzymes, amino acids, phenolic compounds like flavonoids, minerals and other phytochemicals
  - Has antioxidant, antimicrobial, anti-inflammatory properties
  - Scientifically proven to be good for our immune system and improves our well-being

- **We are consuming more honey to build immunity against the COVID-19 infection**
  - Immunity boosting claims by big honey selling companies; Sales were up by 35% until March; would be much more by now
  - With high level of sugar syrup, we are getting empty calories without benefits, which can lead to weight gain
Overweight people are more at risk to COVID-19; So consuming honey that is sugar will make us more vulnerable; more ill – it’s a double jeopardy

- In the US, CDC has said excess weight may have increased risks of severe covid-19 infection
  - Risk expanded to larger numbers of people, who may not be declared “obese” but are “overweight”
- **Now link b/w weight and risk to disease is more clear:**
  - The adipose tissue—the fat in our bodies—is biologically active, promotes low intensity chronic inflammation; makes our body more immune suppressed and more vulnerable to coronavirus diseases
  - Problem of abdominal obesity also adds stress to the lungs
- **Studies are suggesting that the epidemic of obesity and Covid-19 can be viewed as a syndemic**
  - Negatively interact with one another to exacerbate the course of diseases, leading to greater complications and severe illness
Way forward We need pure honey

It is time we outwitted the business of adulteration
Our ask from government, industry and the consumer

- **First:** Need to stop import of syrups and honey from China
  - Regulation is tough; need to stop all imports. It begins the clean-up – but not enough

- **Second:** Need to strengthen enforcement in India public testing so companies are held responsible. Cannot play with our health
  - Including NMR, however important, will be short-term as Chinese companies will design NMR bypass syrups
  - Test samples; make result public and hold companies responsible. If CSE can do this investigation and tests using NMR, FSSAI certainly can do this and more
  - Every honey selling company must be required to be able to trace back the origins of the honey – from the beekeeper to the hive.

- **Third:** We consumers must be able to tell adulteration by the taste, the smell and the colour. Our health is in our hands.
  - Consumer choice for liquid honey shaping business of adulteration; This is why adulterated honey thrives; honey which does not crystallize is no guarantee of a pure honey. **Consumers must demand change** – crystallization of honey is not bad, it is honey properties, for instance
Bees are critical for health of food system

- Because of adulteration beekeepers are going out of business
- Farmers are losing livelihoods
- Without beekeepers there will be decline in bees
- Bees provide crucial service as pollinators
- Without bees we lose productivity of food; we lose life