# Adulterated and Contaminated Honey Purchased Online in Bangladesh Poses Serious Health Risks to Consumers

## বাংলাদেশে অনলাইনে কেনা ভেজাল এবং দূষিত মধু ভোক্তাদের জন্য মারাত্মক স্বাস্থ্যঝুঁকি

Dr. M. A. Samad, PhD, WHO Fellow

According to the Holy Quran Surah An-Nahl (Chapter 16), Verse 69, describes "Allah's blessings through the bee, commending people to eat from various fruits and follow His easy paths, noting that from the bees' bellies comes a multi-colored liquid (honey) that is a cure for mankind."

The following seven commercially marketed honeys, available in the local market and online, were purchased and evaluated; their status is noted at the end of the manuscript.

- Nectar Drops (Sundarbans Honey)
- Saffola Active Plus (Marico BD Ltd)
- Kalo-Jera Honey (Amanot Foods)
- ACI Pure Honey (Multifloral)
- Aussiebee Organic Honey (Australia)
- Kalo-Jera Honey (Nahal Multi-products)
- Pure Honey of Sundarbans (Takwa Shop)

**Summary:**

- Most of the honeys available in the local market and online are adulterated and contaminated and cannot be purified by any method, posing a high health risk to consumers, such as metabolic disorders, organ damage, cancer potential, and others.
- Nahal super-grade Kalo-Jira honey is found to be contaminated, causing digestive troubles, whereas Sundarbans Honey Nectar Drops are very thin (watery) and, on heating, produce foam and bubbles, indicating adulteration.
- Boiling such honey may reduce some contaminating microbes but also pose a serious health risk due to the formation of 5-hydroxymethylfurfural (HMF), which can cause gastrointestinal disorders, DNA damage, liver stress, and a possible carcinogenic risk.
- For consumers: Buy honey from trusted brands or cooperatives with lab certification. Avoid suspicious, cheap products, especially from online suppliers.

For details: link

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## INTRODUCTION

Research reports indicate that honey components exhibit antimicrobial, antioxidant, anti-inflammatory, anticancer, antiproliferative, and antimetastatic properties. According to the Holy Quran Surah An-Nahl (Chapter 16), Verse 69, describes "Allah's blessings through the bee, commending people to eat from various fruits and follow His **easy paths,** noting that from the bees' bellies comes a multi-colored liquid (honey) that is a cure for mankind." Allah teaches us to say in every salat, "Guide us to the straight path." [Al-Fatiha:6]. A person who intentionally adulterates honey or who persistently disobeys the "easy paths of Allah" is considered a disbeliever or a transgressor. The Prophet Muhammad (Sallallahu Alaihi Wasallam) said, "Whoever cheats/deceives is not of us."

Pure honey, the unaltered nectar of flowers transformed by bees, is highly valued globally for its unique flavor, nutritional benefits, and therapeutic properties. Its complex composition- primarily monosaccharides, disaccharides, water, vitamins, minerals, proteins, enzymes, and phytochemicals- is influenced by botanical and geographical origins, which directly impact its quality and authenticity. Honey is primarily 75-80% sugar (fructose 40% and glucose 35%) and 17-20% water, with the rest comprising trace minerals (0.2%), vitamins, enzymes, amino acids (0.3%), and antioxidants; exact percentages vary by floral source.[1]

Globally, the honey market was approximately US$9.01 billion in 2022, whereas the Bangladesh honey market was Taka 1200-1500 crore (>US $100 million) annually, but exported $227k and imported $1.36 million of honey in 2023.[2,3] Bangladesh produced approximately 15,000 metric tons of honey in 2022-2023, of which it exported 97 tons, a 28.5% decline from the previous year.[4] However, this honey production is threatened by widespread adulteration and contamination, where low-cost syrups such as corn syrup and glucose syrup, along with coloring agents like caramel color, are added to increase volume and sweetness.[3]

### Reasons for honey adulteration

Honey adulteration is primarily motivated by economic gain, as the high market value and demand for pure honey encourage fraudulent practices. A gap between limited supply and high consumer demand further incentivizes the addition of cheaper substances to increase volume and profit.

### Honey adulteration

Adulteration of honey refers to the intentional addition of foreign substances to increase the volume or reduce the cost of honey. Honey is often adulterated with inexpensive sugar syrup in two ways: direct and indirect adulteration. During direct adulteration, a specified proportion of syrup is added to harvested honey to enhance its sweetness and bulk the product, whereas in indirect adulteration, bees are overfed with sugar syrups to increase honey yield in hives. The most used sugar syrups for honey adulteration are high-fructose corn syrup (HFCS), corn sugar syrup, inverted sugar syrup, and cane sugar syrup, with HFCS being the most used.

Caramel coloring is often used as it is cheaper, but it reduces nutritional value and may contain antibiotics and contaminants. Excessive heating or processing of diluted low-grade honey alters

natural enzymes and increases 5-hydroxymethylfurfural (HMF), a marker of adulteration. HMF in honey, formed from sugar degradation, serves as a quality indicator; however, levels from heating or storage can signal reduced honey benefits (e.g., antioxidants) and potential risks, including cytotoxicity, mutagenicity, and organ toxicity, including effects on the kidneys and liver.

## Honey contamination

Honey is a high-value natural product that is often adulterated or contaminated during production and processing, thereby reducing its nutritional and medicinal value and posing significant health risks to consumers.[5] It is a growing global concern and is usually unintentional, arising from environmental or handling factors. Studies show that honey can be contaminated with pesticides, heavy metals, antibiotics, and persistent chemicals such as PFAS, often due to environmental pollution, agricultural practices, or processing adulteration.[6] Honey contamination with *Clostridium botulinum* spores has been reported in many countries. Both intentional fraud and accidental contamination compromise the purity and safety of honey, making strict quality control essential. Therefore, honey is used as medicine, and its contamination may pose serious risks to human health.

## Honey adulteration in Bangladesh

- Honey adulteration in Bangladesh is a significant issue, primarily involving the addition of cheaper sweeteners such as sugar syrup (corn or cane) or molasses to increase volume, and is further contaminated by poor processing and storage practices.
- Recent research reports indicate that a significant proportion of honey sold in local markets and online is adulterated, particularly in urban centers such as Dhaka.
- The choice of 10-20% sugar syrup adulteration levels is a common practice within the honey industry in Bangladesh.[7]

## Honey contamination issues in Bangladesh

- Honey contamination in Bangladesh is a significant concern, with studies revealing widespread presence of bacteria, and has been reported to the presence of *Micrococcus luteus* (100%), *Streptococcus* (92%), *Staphylococcus aureus* (77%), *Bacillus* (23%), *Lactobacillus* (15%), *Klebsiella* (8%) and *Escherichia coli* (8%) in commercial honeys in Bangladesh.[8] Recently, clinical signs of digestive disorders caused by online-purchased Nahal Kalo-Jira honey have been recorded.
- Poor hygiene during honey collection and storage can lead to contamination with bacteria, yeasts, and molds.
- Environmental pollution and agricultural practices contribute to contamination of heavy metals such as lead and arsenic, as well as pesticide residues.
- Beekeepers sometimes use antibiotics to protect hives, leaving residues in honey that exceed safe limits.
- Use of low-quality plastic containers can leach harmful chemicals into honey.
- Contamination of honey in Bangladesh is affecting overall quality and purity, and requires better management of microbial loads and adulteration.

## Health risks

Consuming adulterated or contaminated honey can lead to various health problems, ranging from metabolic disorders, allergic reactions, and toxicity to potential long-term risks like cancer and organ damage (Table 1)

Table 1. Status of adulteration and contamination of honey with health impact in Bangladesh

| SN | Issue | Details in Bangladesh | Health Impact |
|---|---|---|---|
| ① | Adulteration with sugar syrup | Common in the local market | Raises blood sugar, reduces nutritional value |
| ② | Microbial contamination | Due to poor hygienic practices | Gastrointestinal disorders |
| ③ | Heavy metals | From environmental/Pollution | Toxicity, organ damage |
| ④ | Antibiotic residues | From hive treatments | Anti-microbial resistance |
| ⑤ | Poor packaging | Cheap plastics | Chemical leaching |

## Risks and challenges

- **Consumer deception**: Adulterated honey can look and taste like pure honey, making detection difficult without lab testing.
- **Health hazards:** Long-term consumption of contaminated honey can contribute to the development of chronic diseases, especially among vulnerable populations.
- **Regulatory gaps:** Bangladesh lacks strong enforcement mechanisms of honey quality standards, allowing adulterated products to circulate widely.

There is no known method for adulterated or contaminated honey to make pure, and consuming boiled, adulterated, or contaminated honey can cause toxic effects such as gastrointestinal irritation, liver and kidney damage, metabolic stress, and increased risk of chronic diseases due to harmful byproducts like hydroxy-methyl-furfural (HMF) and contaminants like heavy metals, pesticides, and antibiotics (Table 2).

Table 2. Key health effects of boiled, adulterated, and contaminated honey

| SN | Factor | Mechanism | Potential health effects |
|---|---|---|---|
| ① | Boiling honey | Heat converts sugar into HMF, a toxic compound | GI irritation, DNA damage, liver stress, possible carcinogenic risk. |
| ② | Adulteration with sugar syrup | Addition of glucose, rice syrup, or HFCS alters the natural composition | Obesity, insulin resistance, diabetes risk, loss of antioxidant/antibacterial benefits |
| ③ | Heavy metal contamination | Lead, arsenic, & cadmium from poor processing, or storage. | Neurotoxicity, kidney disease, developmental issues in children. |
| ④ | Pesticide residual | From contaminated nectar sources | Endocrine disruption, immune suppression, increased cancer risk |
| ⑤ | Antibiotic residues | Used in bee colonies to prevent infections | Allergic reactions, antibiotic resistance, gut microbiome imbalance. |
| ⑥ | Microbial contamination | Poor hygiene during processing | Food poisoning, diarrhea, infant botulism (especially dangerous for babies). |

## Why boiling honey makes it worse

- **Loss of notional value:** Heat destroys enzymes (like glucose oxidase) and antioxidants that give honey its medicinal properties.

- **Formation of HMF**: Even moderate heating accelerates HMF production, which is linked to mutagenic and cytotoxic properties.
- **Synergistic toxicity**: When adulterated honey is boiled, contaminants such as pesticides or heavy metals may interact with HMF, thereby amplifying toxicity.

### Long-term risks of consuming adulterated honey

- Metabolic disorders: Regular intake of adulterated honey mimics high-sugar diets, raising risks of diabetes and cardiovascular disease.
- Organ damage: Chronic exposure to heavy metals and HMF stresses the liver and kidneys.
- Cancer potential: HMF and pesticide residues have been associated with DNA damage and carcinogenesis in experimental studies.

### Practical recommendations

- Avoiding boiling honey: Use raw or gently warmed honey to preserve its natural properties.
- Check authenticity: Buy honey from trusted sources with lab-tested purity.
- Limit used in infants: Never give honey to children under 1 year due to the risk of botulism.
- Watch for labels: Ensure honey is certified free from antibiotics, pesticides, and adulterants.

## Detection of adulterated honey

Detection of adulterated or contaminated honey relies on physical, chemical, and advanced analytical techniques, including spectroscopy, chromatography, isotope analysis, DNA barcoding, and chemometric modeling. These techniques identify added sugars, foreign substances, or contaminants that compromise the authenticity and safety of honey.

### Detection of adulteration of honey at home[9]

Home and laboratory tests are used to detect adulteration in honey. Home tests are simple, and individual tests may not be accurate, but together they provide a good indication.

① **Smell:** Pure honey has a delicate, fragrant aroma hinting at its floral source, e.g., citrus, blossoms, or herbs.

- Pleasant floral aroma = Quality poor honey.
- No aroma or an overly pungent smell = Adulterated honey.

② **Taste**: Genuine honey has a rich, multilayered sweetness. It may be fruity, spicy, or herbal notes beyond just sugar. Adulterated honey usually tastes cloyingly sweet and one-dimensional (syrup-like). •**Complex taste**: Quality poor honey •**Overly sweet:** Adulterated honey.

③ **Water dissolution test**

- Fill a clear glass with room-temperature water.
- Add a spoonful of honey gently to the water.
- Observe without stirring.
- Pure honey will clump together and slowly sink to the bottom (Fig. 1A)
- Adulterated honey will start dissolving immediately, creating cloudy streaks or dispersing quickly (Fig.1B).

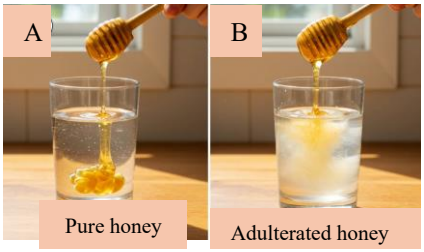

Fig. 1. Water dissolution test of honey

### ④ Thumb/Drop test

- Place a drop of honey on a clean and dry thumb, holding the hand horizontally.
- Pure honey is viscous and sticky, so it shouldn't spread quickly (Fig. 2 A), whereas adulterated honey (with added water/sugars) is runnier and will flow (Fig. 2B).
- Nahal is using this method in online advertisements, just placing a drop of honey on the palate of the hand or two separate drops of two different Kalo Jira honey on a white plate that can't be differentiated by its stickiness.

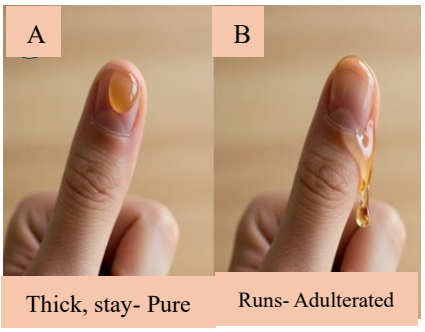


Fig. 2. Thumb/drop test of honey

### ⑤ Flame test

- Dip a dry matchstick or cotton bud into honey, then try to light it.
- Pure honey's low moisture means the match can ignite and burn steadily, whereas if the match won't light, moisture or additives may be present (Fig. 3)

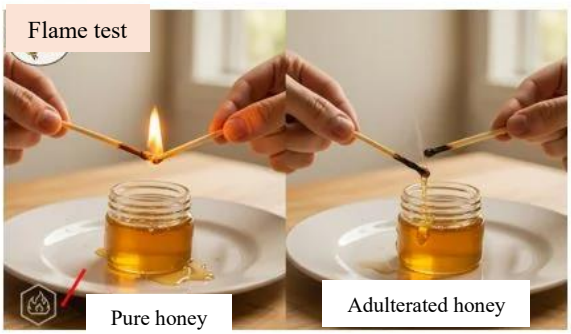


Fig. 3. Flame test of honey


Fig. 4. Heat test of honey

### ⑥ Heat test

- Put a teaspoonful of honey into a metal spoon or a small pan and heat over low heat.
- Pure honey will caramelize and darken but not foam, whereas adulterated honey bubbles, foams, or leaves a soapy residue when heated due to excess water or impurities.
- When the Nectar Drop (Sundarbans Honey) purchased online was heated in a small pan, it produced bubbles like milk boiling.

### ⑦ Method for the quicklime and honey test

- Place a small, equal amount of honey sample into a clean, dry bowl, and mix in a small amount of powdered quicklime (calcium oxide)
- The primary reaction occurs between the quicklime (CaO) and the water ($H_2O$) naturally present in the honey in an exothermic combination reaction to form calcium hydroxide ($Ca(OH)_2$), also known as slaked lime: $CaO(s) + H_2O(l)$--- $Ca(HO)_2$ + Heat energy
- **Pure honey:** The mixture should stay relatively inactive or form a solid mass, as pure honey has very low moisture and is naturally acidic.
- **Adulterated honey:** If the mixture fizzes, bubbles, or produces a significant chemical reaction, it indicates the presence of added water, sugar syrup, or alkaline impurities.
- **Interpretation**: If the mixture produces a significant reaction, it is likely that the honey is not pure.

### ⑧ Vinegar (Acid) test

- Mix 2 tablespoons of honey with ¼ cup of water; add 2-3 tablespoons of white vinegar. If the mixture foams or fizzles, it could indicate adulteration.


Fig. 5. Vinegar (acid) test of honey

- Pure honey is naturally slightly acidic (pH 3.9), so it usually won't react vigorously with vinegar, whereas foam or fizz indicates the presence of alkaline substances or added agents neutralizing the acid (Fig. 5).

- This test helps detect common additives such as syrups or corn syrup, which alter honey's natural pH.

## Modern methods

Modern methods are required to detect honey adulteration, as traditional techniques are no longer effective against increasingly sophisticated, engineered, and 'tailor-made' sugar syrups designed to mimic the profile of genuine honey. These advanced techniques, such as spectroscopy and DNA-based testing, are necessary to identify low-level adulteration and distinguish between C3 and C4 plant sugars.[1]

- Fraudsters now use sophisticated syrups tailor-made from rice, wheat, or sugar beet that are designed to bypass traditional analytical methods, such as stable carbon isotope ratio analysis (SCIRA).
- Complex adulteration: Modern adulteration often involves 'indirect' methods, such as feeding bees sugar syrup, which produces honey that closely matches the chemical profile of pure honey.

## Evaluation of the locally produced honeys purchased online

### ① Nectar Drops (Sundarbans Honey)

The Nectar Drops honey I received online was found to be thinner and watery, and all tested conventional methods showed negative values. When this honey was boiled, milk-like bubbles formed and took a long time to remove the bubbles. Ultimately, the boiled honey was scientifically unfit for human consumption.

### ② Aussiebee Organic Honey (Australia)

Aussiebee is a brand of Australian honey, including organic varieties, known for sourcing honey from native Australian bees (such as stingless bees) and for marketing it internally, especially in Bangladesh, through distributors. I've purchased this honey from a supermarket, which is good but expensive.

### ③ Saffola Active Plus honey (India, Marico BD Ltd)

Saffola active honey is marketed in Bangladesh by Marico BD Ltd., bringing the Indian brand's promise of pure, antioxidant-rich honey to local retailers and department stores. I've purchased this honey from a department store in Dhaka. This does not cause any unwanted health problems for consumers, but it is not the same as high-grade imported Australian Aussiebee organic honey.

### ④ Kalo-Jera Honey (Nahal Multi-products)

**Kalo-Jera Flower honey (High-grade)**

'Nahal multi-products offers healthy, natural foods and premium-quality products. Since its inception, Nahal has been the center of customer trust. With the love and support of our valued customers, we are continuously ensuring better service every day'- Nahal company profile.

I've attracted to see their advertisement, especially the differences between Kalo-Jera (High-grade) and honey, a popular product. Then I ordered two kg of high-grade Kalo-Jera honey online. A company representative called me on my mobile to confirm the order. I asked them, 'If the honey is not pure, and then don't send me,' but he did not reply to anything. Accordingly, I thought my honey order was cancelled. But after one week of ordering, I received 2 kg of honey in 2 separate bottles, along with 2 gift vouchers of Taka 200 each. For breakfast, I had some honey from a bottle, and then my digestive trouble, even diarrhea, started, and the symptoms looked like an *E. coli* infection. Ultimately, diarrhea was cured after taking an antibacterial drug.

I conveyed this honey-contaminated message to the company via their email address and mobile, commented on their products' Facebook, and asked them to replace it with Khalisha Honey, but they informed me that Khalisha Honey is of lower quality than Kalo-Jera honey. Results of all these conventional tests showed that low- to medium-quality honey indicates it is adulterated with contaminated molasses or other substances, or that contamination occurred during processing. However, a modern test would be required to detect the contamination and adulteration of this honey.

Under these conditions, the company has made the email address inactive (mail delivery failure), set the lab tub Facebook status to closed (Error: Not a valid Facebook Page URL), decreased the high-grade and popular-grade Ad online, and closed or deleted comments from the product comment section. Some company mobile receivers sometimes reply that the message will be communicated to the authority, or we will reply to you very soon.

### ⑤ Kalo-Jira Honey (Amanot Foods)

Kalo-Jira honey from Amanot Foods (Bangladesh) is their premium, pure, black seed (kao-jira) flower honey, often promoted as natural and high-quality, available for online purchase with local delivery options in Bangladesh, featuring flavors from the distinct kalo jira flowers, a specialty product from this Bangladesh food supplier. I've purchased I kg of this honey online and am waiting for tests.

### ⑥ Pure Honey of Sundarbans (Takwa Shop)

Pure Sundarbans honey from Bangladesh is highly sought after for its natural, chemical-free quality, sourced from flowers, and is sold by various online shops and directly online. I've purchased 1 kg of honey online and am awaiting test results.

### ⑦ ACI Pure Honey (Multifloral)

ACI Pure Multifloral honey from Bangladesh is a natural, premium honey product by ACI PLC, known for being sourced from various flowers, packed with antioxidants and nutrients, offering energy, boosting immunity, and aiding digestion, through major Bangladeshi online retailers and departmental stores. I've purchased a 250g package of this honey from a department store, but its smell was found unattractive and was not processed for further testing.

It is interesting that most of these online honey advertisers are dressed in Muslim attire and make a Qassam ('oath') like Khoda (an ancient Iranian God) and Allah's Qassam for pure honey. The Qassam is primarily a pledge to Allah; a false oath is considered a danger to one's soul.

## Recommendations

- For consumers: Buy honey from trusted brands or cooperatives with lab certification. Avoid suspicious, cheap products, especially from online suppliers.
- For regulators: Strengthen food safety laws, establish routine testing, and penalize adulteration.
- For Beekeepers: Adopt hygienic practices, avoid antibiotics, and use proper storage containers.
- For researchers: Expand authentication systems using advanced techniques such as NMR spectroscopy, stable isotope analysis, and DNA barcoding to ensure purity.

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