ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)

DOI: 10.5958/2249-7137.2021.02187.X

DETERMINATION OF ADULTERANTS IN HONEY

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ABSTRACT

In this article, an analysis is done based on different studies conducted across the globe on the topic of the use of adulterants in honey. The adulterant of choice for my sample is sugar cane and corn syrup, which is one of the most common adulterants utilized in a variety of honey products. Honey adulteration is a complicated problem in the globe in general and in our nation in particular, according to most studies, and it has a significant economic effect. It may be caused by the introduction of different inexpensive foreign elements. Contamination of honey alters the physiochemical besides rheology of honey, decreasing its nutritional and medicinal properties. As a consequence, methods of adulterate identification and accurate measurement of adulterants would have been utilized to create high grade honey devoid of any foreign addition. Numerous approaches used for honey adulteration detection by maximum researchers, such as, Liquid Chromatography (LC) and Gas Chromatography (GC) analysis, protein characterization, Near Infra-Red (NIR) spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy with Attenuated Total Reflectance (ATR), High Performance Anion Exchange Chromatography with Pulsed Aerometric Detection (HPAEC-PAD), High Performance Liquid Chromatography Coupled to Isotope Ratio Mass Spectrometry (HPLCIRMS), calorimetric methods, Stable Carbon Isotope Ratio Analysis (SCIRA), Fourier Transform (FT), Raman spectroscopy and microscopic detection techniques are appropriate as well as deliver valuable knowledge. However, to get a complete besides dependable result, individuals must not concentrate only on each method, but rather utilize a mix of them.

KEYWORDS: *Adulteration, Analysis, Food, Honey, Methods, Sugar, Syrup.*

INTRODUCTION

Bees and other insects create honey, which is a sticky, viscous food substance. Honey bees store honey in wax structures called honeycombs in which the honey from the Honey bee is the most well-known, owing to its extensive agricultural output and human usage. Bee keeping, or apiculture, is the skill of gathering honey. Honey's taste originates from the mono saccharides fructose and glucose, and it's equally as delicious as sucrose. When used as a sweetener, attractive biochemical characteristics for baking and a unique flavor[1]. Honey does not mature most germs, thus sealed honey does not deteriorate, even after thousands of years. Honey is produced by bees that collect nectar to utilize as carbohydrates to maintain muscular metabolism during scavenge or to be digested as a lasting food supply. Part of the nectar collected by bees is utilized to boost metabolic operation of flying physiques while foraging, with the rest of nectar together meant for spewing, digesting, plus storage as honey. Mature and larval bees use stored honey as nourishment in cold environment or when other food sources remain scarce. People have been able to semi-domesticate bee swarms and harvest excess honey by persuading them to dwell in man-made hives[2].

Honey is classified into groups depending on the floral source and the manufacturing and processing techniques employed. Honeys from various regions of the nation are also mentioned. Honey is also categorized in the United States according to standards for colour and optical density. In general, honey is classified according on the floral base of the syrup used to produce it. Honeys may be produced from specified types of floret nectars or blended together once they've been gathered. Pollen in honey may be traced back to a floral source, and therefore to a particular location[3].

Honey is made up of sugar (approximately seventy-six percent), water (eighteen percent), and other components (about 6 percent). (Roughly 6 percent). Honey's main characteristic (sweetness) is supplied by sugar, which is followed by water (the liquid), and small quantities of other components determine the differences between various kinds of honey. Color, smell, and taste are examples of these differences. Honey includes three kinds of sugar, rather than a single species. Fruit sugar (fructose) has one of the greatest amounts (41 percent) followed by glucose, which has approximately thirty-four percentage, and sucrose, which has between one and two percentage. The proportion of one type of sugar to another is controlled by the floral pasture, supply, and to a smaller degree by the enzyme inverses, which breaks down normal sugar in grapes and fruits as well as in the body of the worker[4].

The following are the constituents:

• Undetermined matter

• Acids

• Proteins

• Minerals

The proportions vary the next. Minerals contribute for 3.68 percent of the total. Minerals in honey grow, despite the fact that the honey does not make up an essential quantity. The elements potassium, arsenic, Sulphur, calcium, sodium, phosphorus, magnesium, silicon, iron, manganese, and copper are all present in honey. Dark honey has a greater mineral content than lighter honey,

based on the measured mean quantity. It was previously believed that bees injected bee venom into honeycomb cells from their stomachs, maintaining the honeycomb. It was believed that honey included formic acid since formic acid is one of the major components of bee spite. Because of this, some individuals encouraged others not to use honey. According to research, honey is made up of a range of acids, the majority of which being apple and lemon acids[5].

Vitamins in honey are in extremely tiny quantities, insufficient for the organism's requirements. Vitamin C and a few B complex vitamins make up the gaps (riboflavin, pantothenic acid, pyridoxine, biotin, nicotinic acid) (riboflavin, pantothenic acid, pyridoxine, biotin, nicotinic acid). Honey has a unique smell that is generated by essential oils. These chemicals are unstable and evaporate quickly when honey is heated. Proteins are present in honey as a consequence of nectar and pollen, which are also natural components of plants. Honey proteins may accept structures or basic chemicals, such as amino acids[6].

Honey fraud is achieved by mixing corn syrup, rice syrup, and cane sugar, each of which can be recognized. Chromatography and mass spectroscopy are employed to monitor the syrup combination. In this situation, infrared and near-infrared measurements are considerably simpler. It is feasible to anticipate that NIR may be utilized to verify the authenticity of high-value single pollen honey, such as Manuka honey, in single pollen honey detection. Principle component analysis, or PCA, may be used in this instance to estimate the honey's origin and species quickly and without the requirement for sample preparation. This has been utilized for a number of food kinds, but not for a thorough study of honey[7].

LITERATURE SURVEY

F. Ulberthpresented that honey is a natural product with a long history of medical usage and has been appreciated for its sweetening properties since ancient times. Honey can only be slightly processed to satisfy internationally accepted standards by centrifugation, mild heating, and, if required to avoid foreign matter, filtration. Honey may be adulterated (extended) by adding syrups (e.g., high fructose corn syrup) that mimic honey's natural sugar content, or it may be mislabeled as to its botanical or floral origins. To identify contaminated honey, detection techniques based on different measuring concepts, such as spectroscopic and chromatographic approaches, as well as combinations thereof, have been developed. To evaluate if honey corresponds to its label statement, multivariate statistics are usually applied to the obtained results[8].

S. Soares*et al.*honey is a popular natural food, not only because of its taste and because of the health advantages it offers. Honey may be classified as a premium product due of characteristics unique region or local climate and flora. Honey is generally regarded as a desirable commodity because of its appealing smell and flavor. As a consequence of improper or fraudulent production techniques and mislabeling sources, honey has become a victim of adulteration. Honey authentication is split into two categories: processing, which involves problems. Both of these issues are addressed in this research, with a focus on techniques for detecting different types of honey adulteration. Honey authenticity has been challenging owing to its dynamic nature and numerous types of adulteration, spurring the development of several advanced analytical methods. As a consequence, a fresh, critical, and thorough evaluation of current or authenticity is given, as well as non-target fingerprint methods. The most current advances in

chemistry, reviewed, with a focus on the benefits and drawbacks of each for identifying botanical and geographical roots[9].

1. Uses of Honey

- Many of the ancient applications of honey are being verified by contemporary study.
- Honey has been utilized to heal wounds and burns because of its supposed fitness welfares. Honey has been proven to have therapeutic benefits in the treatment of wounds in many instances. Honey may be able to help heal wounds, according to a research released.
- Honey has been proven to decrease the frequency and extent of diarrhea. Honey also stimulates you to consume more water and potassium, which is helpful when you have diarrhea.
- Honey has been proven to reduce the increasing inflow of abdominal acid then undigested food by coating the oesophagus besides stomach, according to current research.
- In 2010, experts from the University of Amsterdam's Academic Medical Center claimed in the magazine that honey's capacity to kill germs is attributable to a protein called defensin-1. Study released showed that Manuka honey, a type of honey, may be helpful in treating infections.
- Honey is suggested by the World Health Organization (WHO) as a safe cough treatment for reducing cold and cough symptoms. Honey is also suggested by the Pediatrics as a cough treatment.
- Honey's mild flavor makes it an ideal complement for sugar in the meal. Sugar in the meal adds extra calories to the diet with no health benefit. This will lead to a gain in body mass, which raises the risk of hypertension and diabetes.

2. Adulteration in Honey

A legal word for a food substance failing to satisfy federal or state standards is adulteration. Sugar syrups and molasses inverted by acids or enzymes from rice, sugar cane, sugar beet, and syrups of natural origin such as maple syrup have been discovered in falsified honeys. Honey is indirectly contaminated by feeding artificial sugars to honeybees at the time when broods become spontaneously apparent. Indirect adulteration is one of the most frequent forms of adulteration. Adulteration techniques are constantly developing, and most honey adulteration methods are undetected by the official (legislative) evaluation of honey consistency criteria. Furthermore, while honey's popularity among consumers continues to grow, its worldwide supply is uncertain. Honey is indirectly contaminated by giving synthetic carbohydrates to honey bees when their broods become naturally apparent. It's difficult to detect such accidental adulteration[10].

This page offers an overview focusing on many research performed across the globe on the use of adulterants in honey. Cane sugar and corn syrup, which is one of the most frequent adulterants utilized in a range of honey products, are the adulterants of choice for my research. According to most sources, honey adulteration is a complex issue in the globe in general and in our nation in particular, and it has a major economic effect; it is produced by the addition of different

inexpensive foreign ingredients. Honey that has been contaminated loses its physiochemical and rheological characteristics, decreasing its nutritional and therapeutic potential. As a consequence, adulterate discrimination techniques and precise adulterant quantification may have been utilized to produce high-quality honey that was devoid of any foreign addition. These techniques are helpful and provide significant information on each aspect of honey authenticity; furthermore, in order to obtain a comprehensive and accurate result, individuals should utilize a blend of them rather than relying solely on one.

The Honey Formulation and Development Directive offers standard principles for the formulation and processing of honey. DSC has been explored for application in identifying alteration or adulteration, as well as regulating food hygiene. This technique is used to examine thermal behavior, which is essential for choosing its purity alongside detecting manipulated or contaminated honey. Corn syrup, rice syrup, and cane sugar, each of which can be identified, are used to produce honey scam. The syrup mixture is identified using chromatography and mass spectroscopy, although infrared and near infrared measurements are considerably simpler in this instance.

DISCUSSION

1. Detection Techniques for Adulterated Honey:

Adulteration techniques are constantly developing, and most honey adulteration methods are undetected by the official (legislative) evaluation of honey consistency criteria. Furthermore, while honey's popularity among consumers continues to grow, its worldwide supply is uncertain. Honey is indirectly contaminated by giving synthetic carbohydrates to honey bees when their broods become naturally apparent. It's difficult to detect such accidental adulteration.

Internal norm 12C/13C isotope fractionation mass spectrometry was used to analyze twenty Australian honeys and their associated protein extracts, each from a different floral source. An artificial honey is also confirmed then used for successive dilution of an unadulterated honey to examine how much adulteration might be discovered, resulting in measured apparent adulterations of 2 to 5 percent. The samples are not deemed contaminated because the variances are smaller than the globally accepted threshold of 1 (7 percent adulteration).

Although the lesson established baseline values for specific Australian honeys and showed the applicability of this method, National Residue Survey (NRS) is unable to continue additional study in this area. NRS, on the other hand, will be able to provide scientific resource performing honey study to determine the degree analogue honey reliant on C4 plant sugars. The Australian Honey Bee Industry Council (AHBIC) contacted NSR in February 1999 with the request to undertake finding analogue honey. AHBIC funded the project costs, which were anticipated by NRS to be approximately $1000. The original NRS plan also anticipated that testing each honey sample using C13-C12 isotope ratio mass spectrometry would be required to identify adulteration.

The natural differences that utilize C3 as well as C4 photosynthetic processes are used to identify tainted honey using the isotope method. C13-C12 isotope levels, commonly known as isotope C13 values, vary from 8 percent to 13 percent in C4 plants, such as maize, whereas C3 species, such as nector plants, ranges from 22 percent to 30 percent.

The approved institution contacted to perform the honey protein extractions. However, because the C13 values of honey from different floral sources may vary considerably, there is a broad range of C13 values within which no definite conclusion about the pureness of the honey can be made devoid of further testing. To solve the problem, C13/C12 isotope ratio method for detecting honey adulteration with c4plant was developed. As a consequence, NRS concluded that this method was suitable in order to detect honey contamination with cane sugar or corn syrup.

As a consequence, when it was discovered that isotope ratio method, it was decided to investigate a range of deliberately contaminated honey samples to determine if similar levels of adulteration could be detected in this study.

2. Advances in the Detection of Honey Adulterations:

Aside from the Codex Alimentarius (1981) definition of honey, several nations' and the European Union's (EU) laws have other interpretations. Honey comes in a range of physical forms and formulas. Acidity, water-insoluble particles, moisture, mineral content, 5-hydroxymethylfurfural (HMF) concentration, and apparent reducing sugar alongside apparent sucrose are among the compositional criteria specified in the current honey directive.

Honey adulteration initially appeared on the worldwide market in the 1970s, when the firm introduced high-fructose corn syrup. Since mono saccharides fructose and glucose (85-95 percent) are the most prevalent, the provided honey is largely dictated by the nectar source. To identify adulteration of honey, a variety of analytical methods have been developed, including isotopic, thermal analysis, trace element approaches, spectroscopic, as well as chromatographic. Any of these methods stand time overwhelming, while others are expensive.

Differential Scanning Calorimetry (DSC) is a tool with a broad variety of applications. It's a fantastic method to characterize of them. DSC processing is fast and simple, requires a limited (less than 100 mg), while did not need the usage of solvents. It was used to measure thermal activity in a range of nourishments, even in circumstances wherein heat altercation does not take place. DSC is a useful tool to employ in combination with chemical analytical methods to highlight the limitations of physicochemical findings. DSC has been investigated for identifying alteration or adulteration, as well as for food quality monitoring. Thermal behavior, energy variance during phase transition, transition temperatures, and the water content relationship in honey were all investigated using this technique. For evaluating honey quality and identifying adulteration or alteration, a comprehensive knowledge of its thermal characteristics is required.

The lower glass transition temperatures and greater fusion enthalpies. Honey and syrups have unique Tg locations and intensities, which may be utilized to distinguish them. Pure compounds have a unique owing to their complicated structure. Aside from the Codex Alimentarius (1981) definition of honey, several nations' and the European Union's laws have additional meanings (EU) (EU). Honey comes in a range of physical forms and formulations (crystallized). A proposal to amend Council Directive 74/409/EEC on honey has been approved by the European Commission (EC). This Directive sets broad criteria for the formulation and manufacturing of honey. Honey and honey products have become increasingly popular during the past several decades.

In recent years, honey from the Far East has lately been exposed to a significant adulteration problem. The potential to be deliberately tampered with, expensive besides cultivated under severe, such as honey, are particularly susceptible.

3. Infra-Red Spectroscopy of Honey Adulterations:

While many people are aware of the risks of accidental contamination in the food supply chain, purposeful food adulteration for economic gain has only lately come to light. The melamine pandemic in China in 2007/08 showed this, when a rise in the frequency of kidney failures in dogs and cats alerted authorities to a problem in the pet food supply chain. People now know that the reason was a mixture of melamine and cyanuric acid contained in the pet food. However, the story is not new; fraud and adulteration have been detected as far back as ancient Rome, with wine supposedly contaminated with water. Globalization of supply chains has increased volatility and reduced risk for different parts of the chain in recent years, aggravating the problem. The following are the most common types of honey scam. Corn or rice syrup may be added. For low grade ingredients, single pollen honeys are faked.There aren't current instances, like other types of food theft. Honey was the most contaminated product in the world, according to Dr. Harvey W. Wiley, the first head chemist of the United States Department of Agriculture, in 1889. Wiley brought a bottle of contaminated honey before the United States Congress in favor of the Pure Food and Drug Act, along with a dead bee on top of the thick jelly. He explained that the bee was there to mislead consumers into thinking the honey was 100 percent delicious. Instead, the sweet liquid concealed a variety of harmful chemicals from consumers, according to Wiley. As a consequence, in recent years, considerable focus has been placed on detecting whether honey includes high fructose corn syrup and whether high-value honeys, such as Manuka, are pure and authentic.

Chromatography and mass spectrometry are excellent at detecting adulterants in various types of fraud. Infrared and near-infrared systems, on the other hand, are easier to handle, operate, and speed up, as well as being less expensive, making them an ideal option for honey processing. NIR Spectra of the following pure samples were examined to show the capacity of NIR spectroscopy to detect sugar contamination into various honey kinds. Honey from clover, wildflowers, orange blossoms, organic honey, corn syrup, and rice syrup. It is feasible to anticipate that NIR may be utilized to verify the authenticity of high-value single pollen honey, such as Manuka honey, in addition to identifying corn syrup adulteration. While many people are aware of the risks of accidental contamination in the food supply chain, purposeful food adulteration for economic gain has only lately come to light.Honey fraud is achieved by mixing corn syrup, rice syrup, and cane sugar, each of which can be recognized. Chromatography and mass spectroscopy are employed to monitor the syrup combination. In this situation, infrared and near-infrared measurements are considerably simpler. It is feasible to anticipate that NIR may be utilized to verify the authenticity of high-value single pollen honey, such as Manuka honey, in single pollen honey detection. Principle component analysis, or PCA, may be used in this instance to estimate the honey's origin and species quickly and without the requirement for sample preparation. This has been utilized for a number of food kinds, but not for a thorough study of honey.

CONCLUSION

After the conclusion of all tests, on honey adulteration, it was found that Honey is not always pure, it may be tampered with in a number of ways and identified in a variety of ways. People have a simplistic idea that pure honey can never deteriorate spontaneously, and this is a common truth. But, when honey is poisoned, it merely shows that it was entirely adulterated. Since the isotope method for identifying contaminated honey depends on natural changes in isotopic ratios between C13 and C12 isotope ratios, the approved institution was first called to perform honey protein extractions. As a consequence, the internal standard isotope ratio method may be used to identify honey that has been contaminated with C4 plant sugars.

A proposal to modify the council regulation on honey has been approved by the European Commission. This directive sets standard criteria for the formulation and manufacturing of honey. DSC has been investigated for identifying alteration or adulteration, as well as for food quality monitoring. Thermal behavior (crystallization), were all investigated using this method. Understanding the thermal characteristics of honey is important for evaluating its consistency and detecting adulterated or manipulated honey. Honey fraud is achieved by mixing corn syrup, rice syrup, and cane sugar, each of which can be recognized. Chromatography and mass spectroscopy are employed to identify the syrup mixture, however infrared and near infrared techniques are considerably easier in this scenario.

REFERENCES

1. O. Abbas *et al.*, "Analytical methods used for the authentication of food of animal origin," *Food Chemistry*. 2018, doi: 10.1016/j.foodchem.2017.11.007.

2. C. Beltramo *et al.*, "Validation of a DNA biochip for species identification in food forensic science," *Food Control*, 2017, doi: 10.1016/j.foodcont.2017.03.006.

3. E. Hong *et al.*, "Modern analytical methods for the detection of food fraud and adulteration by food category," *Journal of the Science of Food and Agriculture*. 2017, doi: 10.1002/jsfa.8364.

4. J. Sherma and F. Rabel, "A review of thin layer chromatography methods for determination of authenticity of foods and dietary supplements," *J. Liq. Chromatogr. Relat. Technol.*, 2018, doi: 10.1080/10826076.2018.1505637.

5. T. Cajka, M. R. Showalter, K. Riddellova, and O. Fiehn, "Advances in mass spectrometry for food authenticity testing: An omics perspective," in *Advances in Food Authenticity Testing*, 2016.

6. C. Fanali, L. Dugo, and L. Mondello, "Advances in chromatographic techniques for food authenticity testing," in *Advances in Food Authenticity Testing*, 2016.

7. A. C. A. Veloso, M. E. B. C. Sousa, L. Estevinho, L. G. Dias, and A. M. Peres, "Honey evaluation using electronic tongues: An overview," *Chemosensors*. 2018, doi: 10.3390/chemosensors6030028.

8. F. Ulberth, "Advances in testing for adulteration in honey," in *Advances in Food Authenticity Testing*, 2016.

9. S. Soares, J. S. Amaral, M. B. P. P. Oliveira, and I. Mafra, "A Comprehensive Review on the Main Honey Authentication Issues: Production and Origin," *Compr. Rev. Food Sci. Food Saf.*, 2017, doi: 10.1111/1541-4337.12278.

10. A. P. Sobolev, S. Circi, and L. Mannina, "Advances in nuclear magnetic resonance spectroscopy for food authenticity testing," in *Advances in Food Authenticity Testing*, 2016.