



## Lab Grown Honey: The Next Generation of Sustainable Alternative Nutritional Novel Food

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**Abstract** – Lab-grown honey production is an innovative and developing method of producing honey in laboratories. The technology can produce animal-free honey directly without any bees. Creating lab-grown honey by using synthetic bee stomachs, able to replicate natural honey down to the molecular level but without the need to harm the planet's essential pollinators. In its current stage, lab-grown honey represents a promising technology for delivering products which have so far been produced. In ancient times, honey was considered one of the highly valued and appreciated natural products available to humanity. Honey is not only used for nutrition, but also for health reasons in ancient medicine. It is also used as a substitute for treatment for clinical conditions ranging from wound healing to cancer treatment. Honey is considered to be the most beneficial nutrition for humankind. However, the present conventional production of honey is not sufficient for the increasing population. Lab-grown honey will serve as an adequate replacement for traditional honey. Lab-grown honey has been intended to provide mankind with the necessary nutrients for development. It is basically produced under controlled conditions. It can also provide healthier, more secure, and disease-free honey to people. This assessment illustrates current trends that may spell the first signs of the end for traditional honey and a fresh start for many other bee-free types of research. Due to the development of this technology the present traditional honey market will be affected considerably. There is also

the fact that many existing traditional honey producers will utilize this lab-grown honey technology to stay relevant in the market. Academically, this novel approach is believed to be sufficiently efficient to supply enough honey products to consumers. However, lab-grown honey in production is still in the initial stages of development and needs in-depth research and sophisticated technical skills for enhanced production as well as commercialization. The researcher believes that the future of nutrient-dense foods depends on sustainable and scalable food production that does not negatively impact the animals that must be saved. Real honey is produced without bees. Envision, is the same amazing product, innovatively produced, and with all the added benefits. It will be a comprehensive guide to understanding the science and technology of lab-grown honey, its benefits, and how it can help save the honeybee.

**Keywords:** Lab-grown honey, bee-free, flower's nectar, Bee free honey, Honey Market, Sustainable, Nutrition, Pollination.

### 1. INTRODUCTION

By 2050, the world's population is anticipated to reach 9.5 billion. This population growth, along with social, economic, and demographic changes (such as urbanization, rising incomes in emerging economies, etc.), and the changes in consumer habits that come with them, will put more pressure on the world's resources to produce and provide



more nutritious food and different kinds of food for different diets [1]. The next generation of alternative nutritional novel foods aims to reduce human nutrition reliance on bees and make premium honey available anywhere, at any time. Honeybees use several enzymes produced by their stomachs to make the nectar of flowers easier to digest and better preserved. Honey has distinct features that make it unique appealing in fields such as medicine, cosmetics, and the food industry. Honey is one of the most potent super-ingredients known to man. These days, the honey industry relies on bee honey, which harms bees and their organic social structure [1]. Thanks to innovative technologies, burgers are now made without cows, milk is made without cows, and honey is made without bees. It is an important product that needs to be made in different ways if it is to be made in a sustainable way [8].

The current method of honey production endangers bees and causes price increases. Likewise, the produced honey may contain toxins, pesticides, and antibiotics. Lab-grown honey introduces a revolutionary technology for producing honey without bees. Lab-grown honey enables year-round availability of fairly priced honey, allowing bees to return to their traditional pollination role. The lab-grown honey will have the same flavor, consistency, and nutritional value as honey produced by bees. Lab-grown Honey aims to eliminate the nutritional dependence of humans on bees and make premium honey available everywhere, at any time. Bees are the world's primary pollinators, contributing to the production of food. Yet, commercial beekeeping practices, climate change, habitat loss, and pesticide exposure have made bees extremely susceptible to parasites and viruses. To satisfy the growing demand for honey that is both ecofriendly and sustainable manner, the inventive solution involves producing honey without the use of bees. It's time to make changes to the honey route now that food security and the global

footprint are topics of universal discussion. The researcher believes that the future of nutrient-dense foods depends on sustainable and scalable food production that has no negative effect on endangered animals. Honey produced without bees is genuine honey [2]. Envision is the same incredible product, crafted ingeniously and with all the added benefits. It will be an in-depth look at the science and technology behind lab-grown honey, as well as its benefits and how it can help save honeybees.

## **2. WHAT IS LAB-GROWN HONEY AND HOW DOES IT CREATE SUSTAINABLE BEEFREE HONEY**

Lab-grown beefree honey is honey that has been created in a laboratory. This honey is extracted from the nectar and pollen of flowers, rather than being extracted from beehives. By secreting enzymes in their honey stomachs, honeybees produce honey to make flower nectar easier to digest and more palatable. Honey has certain unique properties that make it valuable in fields such as cosmetics, medicine, and food production [3]. The honey industry is currently dependent on honey made by bees, which is detrimental to the bees as well as their organic social structure.

There are many ways to produce honey without bees. The first is by utilizing plant science to comprehend how bees gain access to the plants and what they acquire from them in order to produce honey [4]. Secondly, how to enhance the molecular structure to measure and produce the product. That is where precision fermentation is used by detecting the organisms that are beneficial in this application so they can be used extensively, meaning in separate ways, such as drizzling on food or cooking with them [6]. Thirdly, how to produce a sustainable "BeeFree Lab-grown" honey that uses the bacterial engineering process, which will produce a nectar-like solution utilizing secreted enzymes that replicate the environment of the honey stomach [3]. The engineered bacteria is going to be isolated from the finished product by using membrane-based capsules, which provide the bacteria's beneficial growth medium in the

capsule while enabling enzyme secretion to an external nectar solution [5]. And it has also developed a synthetic circuit which will control transcriptions of the relevant enzymes, allowing it to manage the definitive composition of BeeFree lab-grown honey and adapt it to the desired applications. Some of the advantages of lab-grown honey include its sustainability, lack of harmful pesticides, and lower price point.

### 3. THE NEED FOR LAB-GROWN HONEY

The global honey industry is valued at \$7.5 billion and employs around 220,000 people. However, the honeybee population has decreased by more than 50 per cent in the past ten years, and scientists are concerned about the future of this valuable resource [7]. There are several reasons for the decline in bee populations, including diseases, pesticides, climate change, and habitat loss. To address these issues, scientists are exploring alternative sources of honey that don't involve pollinating bees. One such source is lab-grown honey.

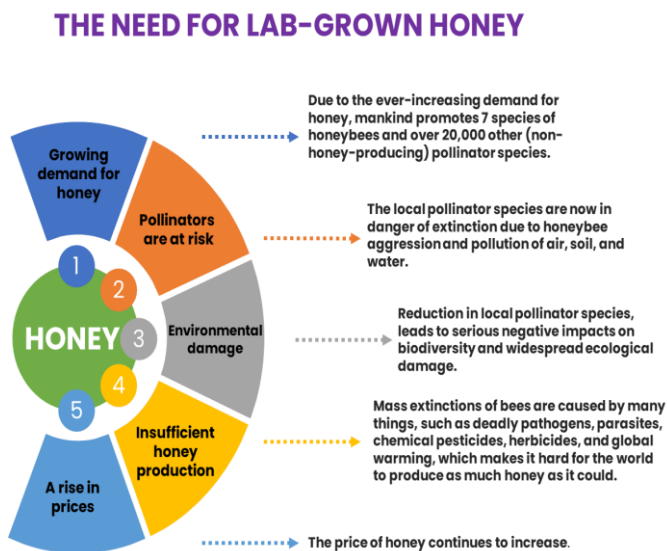


Fig -1: Need of Lab-grown Honey

### 3.1 The current global honey production is not able to meet the high demand.

In the future, when more and more of our food is processed in laboratories, it's likely that we'll see a rise in the demand for lab-grown honey. Right now, only some companies can create this, but as technology improves and prices drop, there's no telling how popular this product will become. In fact, many people believe that lab-grown honey could completely replace all regular honey on the market.

### 3.2 Honeybees are dying at a declining rate, which threatens honey production

Honey is a natural product that has been enjoyed by humans for centuries. It is a sweetener that can be used in baked goods, smoothies, and other recipes. However, the honey-bee population has fallen by over 90% in the past few decades, which has led to the need for lab-grown honey.

### 3.3 Lab-grown honey can help fill the gap in the global honey supply

The world is in need of honey, and it doesn't look like the supply will be able to meet the demand any time soon. The United States produced 9.5 million pounds of honey in 2016, but that's only about a third of what is needed. China is now the biggest producer of honey, producing over 36 million pounds in 2016. There are many reasons why the world is in need of honey. Honey has been used for centuries as a sweetener and preservative. It has antibacterial properties and can treat wounds and infections.

### 3.4 Bees are a vital part of our food production process

Bees are the world's most important pollinators, and they play an important role in the production of our food. However, commercial beekeeping methods, as well as climate change, diminishing habitat, and pesticide exposure, have made bees extremely vulnerable to parasites and viruses. As food security and the global footprint have become hot topics, it's

time to rethink the honey route. Due to the ever-increasing demand for honey, humanity promotes seven species of honeybees and over 20,000 other (non-honey-producing) pollinator species. Honeybee aggression, combined with soil, air, and water pollution, has put local pollinator species at risk of extinction [10]. Local pollinator species decline has serious negative effects on biodiversity and causes widespread ecological damage. Many factors contribute to bee extinctions, including deadly pathogens, parasites, chemical pesticides, herbicides, and global warming, which makes it difficult for the world to produce as much honey as it could.

#### 4. THE TRADITIONAL VS LAB-GROWN HONEY

The traditional honey production method is time-consuming, highly sensitive, dependent on a number of unforeseen variables, and has not been modified in decades. The use of natural nectar substitutes is widespread in this method, resulting in honey of inadequate quality [9].

increased environmental sustainability and food safety. production of the most delicious nectar that Mother Nature can provide.

Phase of the filtration process: The removal of undesirable substances can be accomplished through a process called filtration. The following step was to clean the nectar by removing any unwanted substances and residue that were left over from the extraction process [9].

In lab-grown honey processing, the nectar can be transformed into honey using an innovative machine biosynthesis in lab-grown honey processing. Without adding flavors or colors, the process can make a product that is always the same.

Honey Evaporation: Honey is drained of its water content during the manufacturing process until it has a desirable texture. requires the removal of excess water in order to achieve the familiar honey texture [9].

Final stage Honey: The honey sweet, sticky substance produced by bees from flower nectar. It will be created in the lab. The honey is finished, with the same properties and taste. When compared to the natural honeybee process, this process will be much faster [10].

#### 5. SALIENT FEATURES OF LAB-GROWN HONEY

Lab-grown honey is a new type of honey that is created in a laboratory. It is made from the nectar and pollen of flowers that have been grown in a controlled environment. This type of honey has several advantages over traditional honey [25]. First, it is cheaper to produce. Second, it has a higher level of antioxidants and other health benefits than regular honey. Finally, it is GMO-free, which means that it doesn't contain genetically modified ingredients. Support for sustainability: meet the growing global demand for food through environmentally friendly processes. In order to meet the ever-growing global demand for food, people need to support sustainability. This means that

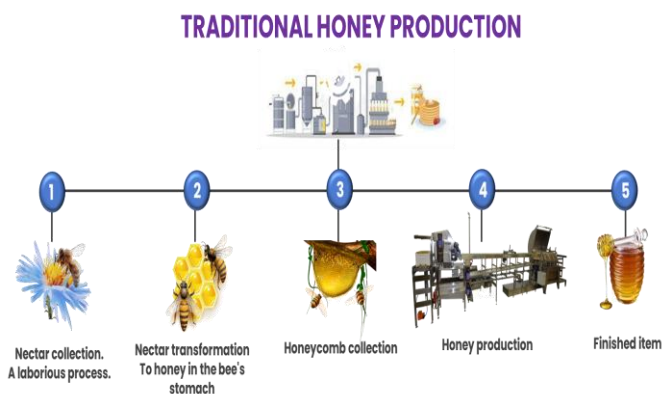


Fig -2: Traditional Honey Production

Take a look at the technology behind lab-grown honey, which can produce premium, eco-friendly honey throughout the year without the use of bees. Production of Nectar: Even though honey is a natural product, there may be some advantages to producing honey in a laboratory, including

people need to find ways to produce more food with less impact on the environment. There are many ways to do this, including using sustainable farming practices, investing in renewable resources, and reducing food waste. Supporting sustainability can help ensure that everyone has access to safe, nutritious food now and into the future [24]. Exceptionally high production capacity provides the same amount of honey as hundreds of beehives through a highly efficient, compact device. The extraction process is safe, environmentally friendly and has no negative effects on bees. The honey is processed instantaneously. The bees are not harmed in any way.

### SALIENT FEATURES OF LAB-GROWN HONEY

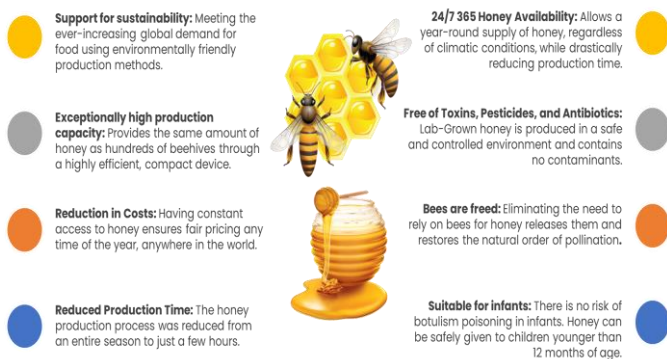


Fig -3: Salient Features of Lab-Grown Honey

**Reduction in Costs:** Having constant access to honey ensures fair pricing at any time of the year, anywhere in the world. It will be a great asset for consumers to buy the honey at a low price that is competitive with what they would receive from conventional methods. **Reduced Production Time:** The honey production process was reduced by an entire season to just a few hours. **24/7 365 Honey Availability:** allows a year-round supply of honey, regardless of climatic conditions, while drastically reducing production time. **Free of Toxins, Pesticides, and Antibiotics:** Lab-Grown honey is produced in a safe and controlled environment and contains no contaminants. **Bees are freed:** Eliminating the need to depend on bees for honey releases them and

restores the natural order of pollination. A Glimpse Into the Future of Honey Production The future of honey production is bright. Everyone thinks that honey made in a lab will help bees survive and keep making honey. Suitable for infants: There is no risk of botulism poisoning in infants. Honey can be safely given to children younger than 12 months of age [23]. safe for pregnant and nursing mothers. In addition, honey is a natural, tasty, and nutritious food for infants.

### 6.OVERVIEW OF LAB-GROWN HONEY, THE MARKET, AND THE SUSTAINABILITY OF THE GLOBAL FOOD SYSTEM

In 2020, the global honey market was estimated to be worth USD 9 billion. Today, the industry is solely dependent on honeybees, and it is confronted with numerous issues concerning sustainability and the negative impact on bee biodiversity [10]. Lab-grown honey is transforming the industry by using science to produce genuine honey, thereby saving 20,000 wild and native bee species that are critical to the Earth's flora and fauna [2]. Lab-grown honey will help to provide the world with the most delicious and nutritious honey available to all, but not at the expense of our planet's sustainability. Many homes and communities will have access to lab-grown honey produced without the use of bees. Lab-grown honey has the potential to change not only the honey category, but the entire sweetener and skincare industries, thanks to a new and sustainable method of producing real honey without bees. The world's first truly vegan honey is lab-grown honey.

Our honey ecosystem is being improved by lab-grown honey. This innovative technology has the potential to have a significant impact not only on global honey production, but also on the entire ecological community. Lab-grown honey is indistinguishable from traditional bee-made honey, and its properties enable food and cosmetic processors to incorporate a wide range of complex sugars into consumer products in a cost-effective and scalable way, potentially with broader appeal.



Demand for honey is increasing, and as all know, there is no environmentally sustainable way to meet this growing demand. Everyone is excited about the new technology innovation journey to solve a tasty problem. The new technology lab-grown honey's mission is to stop the devastating loss of bee biodiversity by producing a better, more sustainable, plant-based honey. Without bees, no one would exist [2]. As part of Sustainable Food Ventures, the entire world supports this new technology for saving bees and all living things.

Finding ways to produce animal foods without using animals is critical for the global food system's sustainability. As a long-time fan of honey and all its benefits, people are very excited about the lab-grown honey initiative to make plant-based honey while preserving bee biodiversity. Honey has unique properties that make it appealing in fields such as medicine, cosmetics, and the food industry [11]. However, many people are unaware that the honey industry seriously harms the environment and has a negative impact on bees. The new lab-grown honey has enormous potential and is expected to have a significant impact in this space. A better future for the planet and bees will be created by the use of lab-grown honey.

### **7.PREVENTING THE EXTINCTION OF HONEYBEES THROUGH LAB-GROWN HONEY**

Honey production is a problem for bees. This seems counterintuitive because manufacturing honey requires the production of more bees [12]. But the honeybee is just one of 20,000 species. Human demand has seen the subspecies of honeybees domesticated and multiplied [13]. Honeybees are insufficient pollinators. They are average, pretty lazy and very specific, and the native species do even more meaningful work. As a result, when they are introduced to unfamiliar habitats, they drive the native species away. If this continues, native bees will become extinct, and honeybees will be the only species left. That would be a disaster for the planet [14].

### **8.HOW BEES ARE CRITICAL TO WORLDWIDE FOOD SECURITY AND HOW THEY GIVE FREE LABOUR SERVICE**

Bees play an important role in global food security. They pollinate a variety of plants, which helps to produce food for humans. In recent years, bee populations have been declining, which has led to concerns about their role in global food security [18]. A future without bees could mean huge food shortages globally, and their potential extinction is a matter of international food security[19]. For years now, biodiversity experts and activists have been alert about the continued decline in the bee population due to habitat destruction, widespread toxic pesticide use, diseases, environmental stressors, and the climate emergency. Efforts are being made to improve bee health and protect them from these threats[20]. The (Food and Agriculture Organization)-FAO says that bees and other pollinators pollinate one-third of the world's agricultural crops for free, adding between USD 235 billion and USD 577 billion to the world's food supply[19].

### **9.GLOBAL WARMING AND ITS EFFECTS ON PLANET EARTH**

The impact of global warming and climate change are among the most significant challenges humanity faces in this century. Humanity has no choice but to find solutions and prepare for the unknown, including the search for new food sources, in light of these challenges. In an effort to avoid or at least mitigate the effects of global warming, it is also possible to develop new applications that reduce pollution and waste, thereby reducing the ecological footprint[22]. People have decided to deal with the environmental risk that the honey industry poses and come up with a way to make honey that doesn't depend on anyone else. They have also decided to challenge young entrepreneurs to look at the



environmental problem from their own point of view and come up with creative solutions.

### **10. HOW TO SAVE BEES AND KEEP THE PLANET'S ECOSYSTEMS RICH AND THRIVING**

Lab-grown honey is a way to protect bees while producing real honey without using bees. Innovative technology will contribute to the future of nutrition and food by ensuring sustainable and scalable food production and distribution without affecting the animals that must be saved. Real honey is produced without bees [16]. Think about the same innovative product being made in an innovative way, with all the extra benefits. Sustainable: save the honeybees. Accessible: Honey that is not affected by seasonal variations and is made available to the world's 7.67 billion citizens. Plant-based: Honey is produced without the use of animals and solely from plants [15].

### **11. WHAT OTHER ENVIRONMENTAL CONSEQUENCES WILL HAPPEN BECAUSE OF THE EXTINCTION OF BEES**

The unsustainable rate at which bees are dying is having profound repercussions for our natural environment. Bees are important for crops because they help pollinate them. If we lose bees, there will be consequences for the environment. For example, without bees to help with crop pollination, the plants will not get the necessary nutrients and will therefore become diseased or die [17]. Additionally, without bees to help with pest control, pests will increase and damage crops even more. In short, the extinction of bees would have many negative environmental consequences. Losing bees would have a ripple effect in all ecosystems, because they play an important role in pollination. The loss of the honeybee population has drastic environmental consequences that researchers are only beginning to understand [16]. Bee pollination is responsible for a third of all fruit and vegetable production, and without bees, crops would not be able to reproduce. This could have widespread economic implications,

not just for farmers but for consumers as well. The bad effects on plant populations could also cause prices to go up because there will be less food for animals and people.

Our planet's pollinators are in peril:

According to recent reports, beekeepers lose 29 percent of all honeybee colonies each winter. Losses can reach 40% at times, and the economic tolerability of the loss is twice as high as it should be. Similarly alarming is the decline of wild bee populations [16]. Bees are essential to the global food supply and their extinction could have serious environmental consequences. The collapse of bee populations has been linked to a number of issues, including climate change, disease, deforestation, and pesticide use. If the bees disappear, it will be difficult to produce crops and sustain our food supplies [17]. The bee is nature's best pollinator, with over 20,000 species. Ninety percent of the world's population's wild flowering plants rely on animal pollination. Without the bee, these plants would severely decline, with catastrophic implications for all ecosystems.

### **12. HOW LAB-GROWN HONEY SECURES BEE POPULATIONS**

For a long time, bee populations have been declining at an alarming rate. There are many theories as to why this is happening, but the most likely cause is a combination of factors, including pesticides, climate change, and disease. In order to help secure bee populations, researchers have been looking into lab-grown honey as a way to replace traditional honey production [21]. So far, lab-grown honey has been shown to be successful in helping to secure bee populations. In other words, it is honey that tastes, smells, looks, and feels like real honey. It also has a similar nutritional value as traditional honey.

### **13. CONCLUSIONS**

Lab-grown honey appears to be a particularly interesting alternative to conventional honey from



bees because of the problems caused by its production methods and its shortcomings in meeting future emerging global demands for protein food availability. In addition, the possibilities offered by the flexible production process and the modification of its composition make it a promising functional nutrition food with the capability to meet the specific needs of many different consumer groups. However, it is even in its initial stages, with no large-scale production technology developed. Important questions, especially moral ones, are still unanswered. Information and the involvement of social stakeholders and consumers in any decisions to be taken is necessary in order to build acceptance through a transparent process. The big challenge of a sustainable future food supply can only be achieved by pursuing a number of viable solutions that will only become effective when combined. Such solutions include the prudent consumption of honey; the abolition of industrial honey farming; the promotion of lab-grown honey; and support for the development and exploitation of plant or other protein sources. Lab-grown honey is among the many possible factors that can contribute to solving the problem. but also influence the industry and educate the public, sparking inspiration and raising awareness regarding the environmental issues they wish to address. This technology has paved the way for innovative, sustainable food production in the future using the tools of synthetic biology, and hopefully for a greener, more aware society.

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