Food Researched: Honey/Bees
Focus of Research: Honey Production Methodology
Name: Sophie Daudon

From Hive to Label:
U.S. Honey Methodology and Production for Dummies

Objective(s)

The objective of this paper is to give U.S. honey consumers accurate information about the processes involved in producing American-source honey. This will be accomplished by:
1. Giving a brief overview of bee activity within the hive.
2. Providing information about basic beekeeping and honey processing in the United States, with distinctions made between small- and large-scale honey production.
3. Unpacking the differences between “conventional” and “organic” honey production in the United States.

Summary of Findings

Introduction

Honey is advertized as one of the most “natural” products consumed in the United States. As the National Honey Board (NHB) states “honey is honey. It’s just that simple.” According to the NHB, an organization responsible for honey “marketing and promotion,” pure honey contains only the “natural sweet substance produced by honey bees from the nectar of plants or the secretions of living parts of plants. Nothing else.” Designed to appeal to customers, the NHB explanation simplifies a complex process and product for the purposes of maintaining the “purity” and “image” of honey as a “wholesome part of the American diet.” Unfortunately, consumer knowledge about honey production, is less than, or limited to, the information contained in the statement by NHB. In order to make informed choices about purchasing honey, it is critical that consumers of honey gain a better understanding of the realities of honey production, from its humble beginnings as flower nectar to the labels used to market it. There is also much to be learned from the bees themselves. As stated by Rowan Jacobsen, author of a recent book about the collapse of honey bees in the United States, bees “have an inestimable intelligence wholly unlike the human variety and well worth comprehending.” Bees not only provide honey, they also play an integral role in producing the

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1 The National Honey Board, for more information on the realities behind this statement see Sarah Robinson’s paper
2 see Anna Reed’s paper
3 Jacobsen 10
food consumed in the U.S., with “at least 30% of agriculture”\(^4\) relying directly on their pollination services as of 2010.\(^5\) Along those lines, Ross Conrad, author of *Natural Beekeeping*, writes “We can learn so much from the honey bee… of all the insects, the honey bee seems to lend itself most perfectly to anthropomorphism…[since it] contributes directly to the abundance found on Earth.”\(^6\) By providing an overview of activity within the beehive, describing basic small-scale and large-scale beekeeping methodology, honey processing, and the differences between “conventional” and “organic” honey production, this paper aims to provide U.S. consumers insight into the process that transforms nectar into the sweet substance purchased in bottles at farmers markets and grocery stores, or contained in products such as Honey Nut Cheerios.

Making Honey from a “Bee’s” Eye-View: Life Within the Hive

No matter where their honey ends up, or how its marketed, honey bees across the United States perform the same basic tasks that result in the transformation of nectar into honey. These processes are dependant on the hive’s interdependent social structure, which provides the backbone for all bee activity. Comprised of fifty thousand individuals, a hive has no central control; instead the bees act as a whole, communicating through dances and hormones to adapt to new environmental conditions. As Jacobsen writes in awe, a “colony of bees really is… a superorganism that thinks quickly, adapts constantly, and depends on wisdom to survive.”\(^7\) Although the hive acts as superorganism, within the hive, there are three different types of bees: female workers, drones (male bees) and a queen bee. The queen bee is an “egg laying slave,”\(^8\) and typically produces all the hive’s offspring\(^9\) using sperm gathered from the drones during a single mating flight taken early in her life.\(^10\) During ovulation, the queen can decide whether or not to fertilize her eggs, thereby controlling the proportions of worker bees and drones within a hive. If left unfertilized, her eggs will produce drones that live only to inseminate a future queen with their genetic information, an achievement that costs them their lives.\(^11\)

Fertilized eggs, on the other hand, usually develop into female worker bees\(^12\) that live for 15-38 days during the summer. Throughout their lifetime, these worker bees perform a variety of hive tasks depending on their stage of development. Additionally, worker bees are responsible for the production of the honeycomb in which eggs, larvae and food sources (i.e. honey and the pollen based substance “bee bread”) are stored.\(^13\) Beginning as cell cleaners, they will become larvae nurses, honey receivers and hive ventilators, among other things, before journeying out of the hive

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\(^4\) NOSB “Formal Recommendation…”
\(^5\) see Anna Reed’s Paper; Jacobsen 6
\(^6\) Conrad 1
\(^7\) Jacobsen 55
\(^8\) Jacobsen 41
\(^9\) The queen secretes hormones called “queen pheromones” that suppress the reproductive abilities of other members of the hive. There are scenarios in which other bees in the hive also begin producing offspring – for example if the queen bee dies. (Hougen-Eitzman)
\(^10\) David Hougen-Eitzman is an entomologist, bee keeper and professor at Carleton College
\(^11\) Hougen-Eitzman, Sammataro 10
\(^12\) Unless they are fed “royal jelly,” a unique combination of pollen, liquid and honey that causes a bee larvae to develop into a queen, rather than a worker (Hougen-Eitzman)
\(^13\) Sammataro 10, 19
as foragers towards the end of their lives.\textsuperscript{14} Despite being close to death, forager bees are incredibly strong. According to \textit{The Beekeeper’s Handbook}, “after all its trips each forager will have travelled about 500 miles before she dies.”\textsuperscript{15} During these trips, the forager collects nectar, pollen and honeydew,\textsuperscript{16} pollinating flowers as she goes, before returning to the hive to drop off her goods.\textsuperscript{17} At the hive, the forager bee empties the nectar from her honey sac and gives it to two or three receiver bees that “work the nectar by extending their tongues and exposing the droplet to the warm air.”\textsuperscript{18} This process helps cure the nectar into honey by evaporating some of the 80% water that is in nectar. Honey ripening is then completed in ventilated honey cells\textsuperscript{19} after one to five days, eventually ending with 18% water content.\textsuperscript{20} When the honey is ready the bees will cap the cell with wax secreted from their wax glands.\textsuperscript{21}

Since the process of making only a cell of honey requires significant bee labor, to produce the equivalent of a “standard jar” of honey, bees must make over a million flower visits.\textsuperscript{22} Furthermore, beehives face challenges such as diseases, varroa mite infestations and Colony Collapse Disorder.\textsuperscript{23} Despite these challenges, and the miniscule amount of honey each bee can produce, in a year with plenty of nectar sources available, one honey hive can yield 100 lbs of surplus honey.\textsuperscript{24}

Humans and Honey Production

In general, U.S. apiculture operations can be divided into two major groups: small-scale, local productions and large-scale, migratory productions.\textsuperscript{25} Local operations tend to draw from fewer hives and produce single source honey. Alternatively, larger operations typically transport their hives across the United States on flatbeds, following the flowering season to maximize production. However, an even more powerful incentive for migratory beekeeping is the money made by hiring out hives for pollination, work that currently provides a higher source of income than honey sales.\textsuperscript{26}

Regardless of size, most apiculture operations use modern honey hives, comprised of stacked wooden boxes called \textit{supers}, which have different depths and an entrance on one side.\textsuperscript{27} Rectangular wooden \textit{frames} rest within the supers and include a honeycomb \textit{foundation}, upon which bees secrete wax to build up honeycomb cells.\textsuperscript{28} Beekeepers use different hive covers

\footnotesize
\begin{enumerate}
\item Sammataro 11, 20, 27; Jacobsen 38
\item Sammataro 21
\item a liquid secreted by aphids (Sammataro)
\item Hougen-Eitzman
\item Sammataro 20
\item Keeping the hive well ventilated to ensure that the dehydration process occurs and hive temperature is maintained is a critical worker task, especially since activity in the hive is temperature dependent.\textsuperscript{19}
\item Jacobsen 38
\item Hougen-Eitzman, American Beekeeping Federation
\item Wild
\item see Anna Reed’s paper
\item Hougen-Eitzman
\item Conrad 13
\item see Anna Reed’s paper
\item Sammataro 25, American Beekeeping Federation
\item Sammataro 28
\end{enumerate}
depending on type of beekeeping they practice. Telescoping covers are better for sedentary beehives in wetter climates, due to their hanging edges, while flat migratory covers are better for stacking and strapping hives together for transportation.29

Honey Harvest and Extraction

The honey harvest usually occurs in Fall, after all honey frames have been filled and capped; although in some regions, where nectar is particularly abundant, two honey harvests can be expected.30 To access the hive, both for general care and honey harvest, a smoker must be used to prevent bees from attacking. Because bees start eating honey when exposed to smoke, perhaps an adaptation to protect themselves from forest fires, smoking the hive will distract them from the beekeeper intruding into their hive.31 Bees can be removed from full honey supers using a variety of methods ranging from gently brushing them off, to blowing with a modified leaf blower.32

After removing honey-filled frames the honey needs to be extracted from the honeycomb. The Beekeeper’s Handbook warns that honey extraction is “a messy process that will try the patience of all involved,” but luckily “the reward is worth the effort.”33 Extraction occurs in the honey house, which is a space carefully designed to maximize efficiency and maintain the proper temperature, so that the honey does not become damaged or crystallized. Like the hive, a honey house has a ventilation system to keep the honey properly dehydrated.34 Small-scale beekeepers use a knife, usually heated, to cut off the wax capping, while larger scale beekeepers may use a more advanced machine.35 The frames are then placed into a honey extractor, which is a round, keg-shaped machine that uses centrifugal force to expel the honey from the honeycomb. According to the experts quoted on Beesource.com, an active online beekeeping community, “as soon as honey is removed from its sealed state, deterioration begins”36 so it must be handled extremely carefully from extraction onwards.

Honey Filtration and Processing

It is during the filtration and processing of honey that the methods used by different honey producers begin to diverge more drastically, since the extent to which honey is processed influences its final state. Raw honey, for example, goes through no filtration whatsoever and contains all of honey’s original ingredients, while ¾ of honey sold in the United State is heavily filtered to the extent that it loses valuable components.37 Generally, small-scale, local honey producers process their own honey, while large-scale operations strain minimally before selling in bulk to a packer who will process the honey further.38 On Beesource.com, as well as on the National Honey Board

29 Sammataro
30 Sammataro 75, Wild
31 Hougen-Eitzman
32 Sammataro 76; Detroy; SueBee Honey
33 Sammataro 80
34 Detroy
35 Hougen-Eitzman, Sammtaro, Detroy
36 Detroy
37 see Sarah Robinson’s
38 “United States Honey Standards”
website, it is emphasized that the highest priority of processing should be providing “the consumer with a high-quality product.” In an effort to ensure that consumers get a reliable product, the United States Department of Agriculture (USDA) has standards for honey quality, based on aroma, clarity, level of defects (i.e. particles found in honey) and color.

Honey is filtered and processed by alternative heating and straining, which has to be done carefully so as not to disrupt the flavor, color and aroma. After the honey has been extracted, it flows through particle-removing screens into a bucket or tank known as the sump. From there it is pumped into a settling tank where it sits at 100°F, a temperature at which separation occurs, before going through further cycles of heating and straining. Although heat is a critical and helpful part of the process, it must be used with great caution because honey is easily damaged and important nutritious components, such as pollen, can be easily lost. Extreme heating, also known as ultrafiltration, more commonly occurs in large-scale processing plants that incorporate imported honey into their marketed product. After processing, honey can be stored in a variety of containers from bottles to bulk containers, depending on the target market.

Selling the Honey

Small-scale honey producers tend to bottle and sell their own honey, marketing it as local and unprocessed, which increases “regional appeal.” On the other hand, as mentioned above, large scale and/or migratory apicultural productions typically sell their honey wholesale to packers in larger containers. Some large-scale beekeepers have large tanks that store 1,000 gallons or more of honey, which is then pumped into tanks on trucks to be transported to bottling factories that combine honey from hives across the country. Some of these honey producers are part of honey cooperatives such as SueBee Honey, the largest honey producer in the United States. Under a cooperative business model, SueBee “buys the member producer’s crop and processes, packs and distributes the products under the cooperative label.” Through large cooperatives or packers, honey is also sold in bulk for industrial consumption in baked goods, restaurants, candies and other processed foods. One of the greatest differences between small and large-scale honey production is the difference in price; a 12-ounce bottle of single source honey can sell for around $11.00, while a 12-ounce SueBee clover honey, costs around $6.50.

As with many other food products, honey is often marketed using appealing words such as “natural” and “organic.” In fact, both the NHB and The Beekeepers Handbook advise honey sellers

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39 Detroy
40 “United States Honey Standards”
41 Sammataro 123
42 Detroy
43 see Sarah Robinson’s paper
44 Detroy; SueBee Honey
45 Sammataro 123
46 Detroy; SueBee Honey
47 SueBee Honey
48 Detroy
49 http://www.marshallshoney.com
50 AmericaGrocer.com
to use the word “natural” on their label to increase sales. The NHB is careful to point out that although the Food and Drug Administration has a “specific position on natural,” they have no “formal” rules. “Organic,” on the other hand, is a term associated with USDA standards of agricultural production and can be less freely used, particularly since the USDA organic seal verifies that a product was created following certain agricultural methodological requirements. To increase consumer demand honey producers frequently include the USDA organic seal on their products. However, within the honey world there is a heated debate about whether or not organic honey actually exists.

“Conventional” versus “Organic”: Is there really a difference?

Although there are methodological differences between conventional and organic practices, primarily in terms of chemicals applied to the hive, beekeeping experts argue that organic, chemical-free honey is impossible, or at least nearly impossible, to produce in the U.S. In his Scientific American blog post “Organic Honey is a Sweet Illusion,” entomologist Alex Wild explains that producing organic, chemical free honey is “beyond the ability of most beekeepers” because they “operate within a bee’s flight of pesticides.” The unique ability of bees to capture pollen on their bodies further increases the likelihood that they will gather harmful environmental particles on their way back to hive, leaving beekeepers with “no control over what their bees are bringing home.” Furthermore, Wild points out that even if the average foraging radius is carefully monitored by organic producers, in times of scarcity “bees will fly more than twice as far.” Wild adds that contamination has recently been found even closer to home, in the honeycomb foundation used to start the hives; results have shown that 98% of commercially sold foundation is contaminated with pesticides. In a related article surveying 60 honey products commonly sold in the Pacific Northwest, Andrew Schneider supports Wild’s viewpoint, reporting that “government, academic, and industry experts insist that U.S. organic honey is a myth.”

And, in fact, despite the high level of honey labels bearing the USDA organic seal, there are no official USDA standards for Organic Honey. Instead the USDA Organic Standards webpage provides a link to the most recent organic apiculture recommendations made by the National Organic Standards Board (NOSB) Honey Task Force in October 2010, which have not been legally adopted. In the document, the methodological requirements of organic are more clearly specified. It is recommended that bees are “designated as organic livestock,” while the products they make can be “sold, labeled or represented as organically produced, if managed in accordance with organic...

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51 Sammataro 124; The National Honey Board
52 The National Honey Board
53 USDA – Organic Standards
54 Brookfield Farm; Organic Consumers Association
55 Schneider, Wild
56 Wild
57 Mullin et al.
58 Schneider
59 Schneider
60 USDA – Organic Standards, NOSB “Formal Recommendation...”
standards for at least 60 days prior to the collection of organic apiculture products.”61,62 To account
for the foraging involved in apiculture production, the NOSB document states that forager bees
must have access to “forage produced in accordance with organic standards,” and that organic hives
cannot be within 2 miles of potentially contaminating areas such as “sanitary landfills” or “crops
sprayed with prohibited substances.”63 The document also recommends prohibiting the use of
pesticides, antibiotics, sulfa products or chemical bee repellents in or around the hive.64

Although studies have shown that regardless of method, the “average hive contains traces of
five or more pesticides,”65 the NOSB Honey Task Board, along with advocates for organic
beekeeping, maintain that chemical-free methods make a difference, especially in light of recent
hive challenges such as Colony Collapse Disorder (CCD).66 While some producers make this
argument for marketing purposes,67 other beekeepers choose chemical free methods for moral,
ideological, ecological and bee health reasons.68 These advocates tend to favor local, small-scale
productions that can remain viable using organic methods, and criticize large-scale, migratory
producers who rely on antibiotics and inorganic feed to help their bees survive the stresses of
transportation.69 Some of this criticism is well founded, as conventional honey producers have lost
significantly more hives than organic in the CCD disaster.70 Organic beekeepers agree with Ross
Conrad, author of Natural Beekeeping, when he states that organic beekeeping is more in tune with
the original sustainable and “biological… big picture” of natural systems.71

Overall, it is important to keep in mind that even though organic, chemical-free beekeeping
may not have significant impact on the honey itself, the methodology used certainly has impact on
the health of the hive. However, it should be clear to the consumer that the USDA organic label
indicates nothing about how the honey was produced. Speaking directly to the honey producer is
currently the only reliable way of determining the methods used to make a given bottle of honey.

Conclusion

Clearly, a tiny droplet of nectar collected by a forager bee goes through a long and multi-
step process to become the advertised product many Americans love and consume regularly. By
understanding the methodology involved in honey production, as well as the differences between
different types of honey, consumers can make more informed choices regarding the systems and
practices they support with each honey purchase.

61 NOSB “Formal Recommendation” 1.1.1.
62 The USDA Organic Standards webpage specifies that treatment of organic livestock must meet “animal health and welfare standards,” cannot “use antibiotics or growth hormones,” must use “100% organic feed” and provide “animals access to the outdoors.”
63 NOSB “Formal Recommendation…” 1.1.2.
64 NOSB “Formal Recommendation…” 1.1.4.1.-7.
65 Schneider
66 see Anna Reed’s paper
67 The National Honey Board, SueBee Honey “Organic?”
68 Sharon Latshchuk in Jacobsen 72
69 Conrad
70 see Anna Reed’s paper
71 Conrad
Sources


“Formal Recommendation by the National Organic Standards Board (NOSB) to the National Organic Program (NOP),” 28 Oct. 2010 www.ams.usda.gov/AMSv1.0/getfile?dDocName...


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http://www.ams.usda.gov

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