HONEY AND ITS CONTAMINANTS

Humans have been collecting honey for food, for more than 8,000 years and production is on the increase. Today though, honey contamination, adulteration and honey-bee colony losses pose a raft of twentieth century challenges.

Table 1. Honey & Beekeeping - Sources of Contamination

TYPES OF HONEY CONTAMINATION	BEEKEEPING CONTAMINANTS
Environmental contaminants	Acaricides: lipophilic synthetic compounds and nontoxic substances such as organic acids and components of essential oils
Heavy metals such as lead, cadmium and mercury	Antibiotics used for the control of bee brood diseases, mainly tetracyclines, streptomycin, sulfonamides, and chloramphenicol
Radioactive isotopes	Paradichlorobenzene, used for the control of wax moth and chemical repellents
Organic pollutants, polychlorinated biphenyls (PCBs)	
Pesticides (insecticides, fungicides, herbicides and bactericides)	
Pathogenic bacteria	
Genetically modified organisms	

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Health conscious consumers and increasing globalisation are driving the honey markets. In the five years to 2010 global honey production increased by 10%, from 1.4 million tons to 1.54 million tons. By 2015, the global market for honey is projected to exceed 1.9 million tons.

Honey's properties as a natural product make it popular in existing and emerging markets. However, it is susceptible to contamination from a variety of environmental sources. Bee products, including honey, are polluted via different sources of contamination (Table 1).

The main concerns for the industry relate to pesticides, antibiotics and microorganisms.

Pesticides are used worldwide to control bee diseases and pests in apiculture. However, in most instances their administration is uncontrolled and they are applied without approved protocols. The substances are used to control varroatosis and ascospheriosis such as acaricides amitraz, celazole, bromopropylate, coumaphos, flumethrin and taufluvalinate. The use of chemicals inside a beehive risks direct contamination of honey. Additionally, in agriculture, pesticide use is common practice as a means of increasing productivity. Pesticide residues include acaricides, organic acids, insecticides, fungicides, herbicides, and bactericides. Uncontrolled application can cause contamination to the environment, animals and humans. More than 150 different pesticides have been identified in colony samples.

Apiarists use antibiotics to treat bacterial diseases in the hive. As a result, traces can be found in the honey itself. Next to others, oxytetracycline and chloramphenicol residues have been found above the regulatory standards in honey. Oxytetracycline is commonly used to treat European foulbrood disease and American foulbrood diseases. Other antibiotics are also used, including but not limited to, erythromycin, lincomycin, monensin, streptomycin, and enrofloxacin. Antibiotic residues are predominantly the result of improper beekeeping practices and have been found to be above the regulatory standards for food.

Bacteria, moulds and yeast microbes are also found in honey. The presence of these microorganisms has the potential to affect honey quality and safety. Fortunately, most bacteria and microbes cannot grow or reproduce in honey but spore forming microorganisms, such as *Bacillus cereus, Clostridium perfringens and Clostridium botulinum*, can survive in honey as spores for a long time.

Another concern is about honey contaminated with pollen from genetically modified organisms (GMO). In the European Union (EU), such a honey product is considered as 'Food produced from GMO' and would require legal approval and respective labelling before it could be offered for sale.

Because of its high nutritional value and unique flavour, the price of natural bee honey is relatively much higher than that of other sweeteners. Therefore it is also susceptible to adulteration with cheaper sweeteners. Sugar syrups and molasses inverted by acids or enzymes from corn, sugar cane, sugar beet and

syrups of natural origin such as maple have all been detected in adulterated honeys. Adulteration of pure honey with synthetic honey (based on C4 plant sugars) has become more prevalent in recent years. In addition, there has recently been a major adulteration problem in honey from the Far East.

Therefore it is no surprise that in recent years, the market has seen the introduction of legislation to ensure honey quality and consumer safety in major markets. This has resulted in major producing countries like China, Turkey and Argentina cleaning up production to facilitate trade. However, contamination remains an issue. Between 2002 and 2004 honey originating from China was banned in the EU, due to contamination with antibiotics. In 2001, the USA introduced an anti-dumping duty on Chinese honey, which was linked to the EU ban. Imports to the USA declined to just 1,530 tons in 2011 and remain low today. On the other hand, from 2001-2011, USA imports of Indian honey increased from 20 tons to 26,837 tons accounting for 20% of the volume in 2011, up from 9% in 2006. According to a 2011 US report, there is strong suspicion that a considerable portion of imports from India are of Chinese origin raising the need for identification of geographical origin. In June 2010, the EU banned Indian honey due to a lack of traceability regarding origin, adulteration, and contamination by heavy metals and antibiotics.

EXPORT REGULATIONS

Supporting these policies, the EU and USA have introduced regulations to guide and qualify exporters before honey can be traded to these important markets.

In the EU, exporters must meet the requirements of European Commission Regulations No 178/2002, No 852/2004 and No 853/2004 and have an HACCP based food safety system implemented. Maximum residue limits (MRL) for pesticides are listed in Regulation No 396/2005. The EU's standard for antibiotics in food stipulates that each antibiotic must have an MRL, as listed in Regulation No 37/2010 before it can be used on a food-producing species. However, there are no MRLs for honey, which means the use of antibiotics for the treatment of honey-bees is not allowed. All honey exported to the EU must be monitored for residues in compliance with Directive 96/23/EC. Moreover, the honey must be the product of one of the countries allowed to send honey to the EU. Each year, the EU updates this list. The current list can be found in Commission Implementing Decision 2012/302/EU. Finally, EU requirements on honey intended for human consumption laid down in Directive 2001/110/EC.

In the US, there are no import restrictions specific to honey. However, exporters must comply with US food standards in relation to food safety and the use of additives and veterinary medicines. MRLs for antibiotics in food are set by the US Food and Drug Administration (USFDA) and listed in Title 21, Part 556 3. There are no specific limits for antibiotics in honey but no food in the US may contain residues of nitrofurans, chloramphenicol and fluoroquinolones.

GROWING MARKET

With no sign of honey's popularity abating the market will continue to grow, and bans and restrictions will enable new players like Ethiopia to enter the market. Producers and exporters must continue to monitor environmental contaminants and use third-party testing and certification to ensure products meet the regulatory requirements of destination markets.

For further information please visit our website www.foodsafety.sgs.com.

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HONEYBEE COLONY COLLAPSE DISORDER

Since 2006, the US and EU have seen large-scale unexplained losses of 30-90% of honey-bees in some colonies. The phenomenon, described as colony collapse disorder (CCD), was partly responsible for a 2% decline in world honey production in 2006-2007.

As of 2012, CCD remains an ongoing problem for the honey industry, with the US being hardest hit. In the EU, CCD is expected to contribute to a decline in honey production, particularly in southern European countries (Portugal, Spain, Italy and Greece) and further north in Poland. These losses impact global honey markets, as the US and EU compensate for lost domestic production.

No definitive cause has yet been identified for CCD. Most researchers believe it is a combination of contributory factors, including:

- The invasive varroa mite
- New or emerging diseases, such as Israeli Acute Paralysis virus and the gut parasite Nosema
- Pesticide poisoning, through exposure to pesticides applied to crops, or used for in-hive insect/mite control
- Bee management stress
- Modification of bee foraging habitats

Research into the potential causes continues.