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Honey quality requirements of the European market

Dr. Klaus Beckmann

Vietnam/Symposium Oct10

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Quality Services International

Institute for

- Quality Control of food, cosmetics, pharmaceuticals and commodities
- Product Development
- Quality Management
- Training and Support

Vietnam/Symposium

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The QSI Lab

- Accreditation: EN/ISO 17025 by AKS
- Employees: > 50
- Qualifications: chemists, biologists, food chemists, pharmacists, biological/chemical technicians, personal for sampling, marketing & sales group



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Equipment and Methods

- Gas chromatographic systems (GC), GC-MS
- HPLC systems, LC-MS/MS
- Isotope mass spectrometry
- Equipment for: conventional chemical analysis, microbiological analysis, physical measurement
- Organoleptic tests
- Microbiological analysis





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Honey quality



The **consumer** wants:

- an authentic honey, not blended with other sweeteners/products
- a pure and healthy product
- a good taste
- safety, that the honey does not contain residue substances.

⇒ Therefore food/honey quality has to be defined.





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Who determines Honey Quality?

Legislation

International Recommendations

Codex Alimentarius

valid for honey trade in the whole world

European Community Legislation

EC Regulations, EC Directives

National Law

**e.g. German Food Regulation (LFGB)
and related Directives
(German Honey Directive)**



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Who determines Honey Quality?

Associations:	e.g. German Beekeeper Association (protection of national products)
Exporters, Factories, Beekeepers:	Economic aspects
Importers, Packers:	Inspected by authorities QM-System Requirements of shops Specifications
Shops:	Consumer expectations Marketing Trade specifications
Consumers:	Public opinion Consumer magazines TV



Quality control by consumer means:

- Acceptance or rejection of products from the market
- Usually consumers have definite expectations on how the product should look like, taste, smell etc.
- Verbal propaganda





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Monitoring by consumer organisations

Example: Germany

- Consumer protection organisations perform comparative tests of products and services to provide independent and objective support to the consumer.
- Results are published in respective journals.
- Test results are highly accepted not only by the consumer but also in trade.
- Positive test results are often used in advertising.
- Most famous in Germany are:
 - 'Stiftung Warentest'
 - 'Ökotest' (focus on organic production)





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„Stiftung Warentest“

Nektar und Honigtau

Honigsorten im Test

Mischblütenhonig stammt aus dem Nektar von Blüten verschiedener Pflanzen. Er variiert in Farbe, Geruch, Geschmack und Konsistenz. Je nach Erntezeitpunkt unterscheidet man zwischen Früh- und Sommertracht.

Bergblütenhonig kommt aus Gebirgsregionen, im Test vor allem aus Süd- und Mittelamerika. Seine Farbe ist hellgelb bis golden, die Konsistenz feincremig. Er schmeckt lieblich-blumig und aromatisch.

Wildblütenhonig ist gelb bis bräunlich, bleibt lange flüssig und schmeckt aromatisch. Er muss überwiegend von verschiedenen, wild wachsenden Blütenpflanzen stammen. Der Anteil an Nutz- und Kulturpflanzen darf nicht überwiegen.

Akazienhonig machen die Bienen nicht aus dem Nektar der Akazie, sondern der Robinie – auch Scheinakazie genannt. Deren Blüten sind pollensarm, sodass im Honig nur 20 bis 30 Prozent Robinienpollen zu finden sind. Geschätzt wird Akazienhonig wegen seines milden, fein-süßen Geschmacks, zum Beispiel im Tee und in Süßspeisen. Er ist blass, fast farblos und flüssig.

Raps- und Rapshonig schmeckt mild-blumig bis kohlsüß. Seine Farbe ist weiß. Er kristallisiert schnell und fein, seine Konsistenz ist cremig.

Sonnenblumenhonig ist dottergelb wie die Blüten, aus denen die Bienen den Nektar dafür sammeln. Er kristallisiert schnell und schmeckt mild-aromatisch wie Traubenzucker.

Waldhonig zeichnet sich durch sein malziges und würzig-herbes Aroma aus. Er ist rot- bis dunkelbraun und meist dickflüssig. Die Bienen gewinnen ihn nicht aus Blütennektar, sondern aus Honigtau von Laub- und Nadelbäumen in Wäldern. Honigtau besteht aus zuckerhaltigen Ausscheidungen von pflanzensaftsaugenden Blatt- und Schildläusen.



test Honig

		Mischblütenhonig ohne Sortenangabe					Bergblütenhonig							
		Aldi (Süd) / Goldland Bienenhonig Auslese	Edeka / Gut & Günstig Bienenhonig flüssig	Aldi (Nord) / Imkerhonig Vom Besten	Tip Bienenhonig Auslese	Kaufland / K Classic Blütenhonig flüssig	Kaiser's Angelmann / Star Marke Blütenhonig	Lidl / Marlene Sommer-Blütenhonig Feine Auslese Goldklar ⁸⁾	Plus / Amiel Ausrelesener Honig Gold-Klar	Langnese Bergblüten Honig	Langnese Flotte Biene Gebirgsblütenhonig	Bihophar Auslese, Wabenecht Gebirgs-Blüten-Honig	Bienenwirtschaft Meissen Wabenechter Gebirgs-Honig, Imkerhonig	Breitsamer Gebirgsblüten Honig, wabenecht
Gewichtung														
Deklarierte Herkunft ¹⁾		Nicht-EG	Nicht-EG	EG, Nicht-EG	Nicht-EG	Nicht-EG	Nicht-EG	Nicht-EG	EG, Nicht-EG	Nicht-EG	Nicht-EG	Nicht-EG	EG, Nicht-EG	EG, Nicht-EG
Mittlerer Preis in Euro ca. / Inhalt in g		1,69 / 500	1,69 / 500	1,69 / 500	1,69 / 500	1,69 / 500	2,89 / 500	1,69 / 500	1,79 / 500	3,50 / 375	2,49 / 250	3,50 / 500	3,60 / 500	4,00 / 500
Mittlerer Preis pro 500 g in Euro ca.		1,69	1,69	1,69	1,69	1,69	2,89	1,69	1,79	4,67	4,98	3,50	3,60	4,00
test-QUALITÄTSURTEIL	100 %	GUT (1,9)	GUT (2,0)	BEFRIEDIGEND (2,7)	BEFRIEDIGEND (3,5)	AUSREICHEND (4,0)	MANGELHAFT (5,0)	MANGELHAFT (5,0)	MANGELHAFT (5,0)	GUT (2,1)	GUT (2,1)	GUT (2,2)	GUT (2,3)	BEFRIEDIGEND (2,8)
test-Kommentar		Bester Mischblütenhonig im Test, ohne Wärme- und Altersschädigung.	Durchweg guter Mischblütenhonig.	Mischblütenhonig mit beginnender Kristallisation. Schädigung durch Lagerung, Alterung oder Wärme schon erkennbar.	Beginnende Kristallisation widerspricht Deklaration „klar“.	Beginnende Kristallisation widerspricht Deklaration „flüssig“. Schädigung durch Lagerung, Alterung oder Wärme schon erkennbar, viel zu lange MHD-Frist.	Darf aufgrund des zu hohen HMF-Gehalts nicht als Honig bezeichnet werden. Viel zu lange Mindesthaltbarkeitsfrist.	Ist aufgrund des hohen Stärkegehalts (honigfremde Bestandteile) kein Honig im Sinne der Honigverordnung.	Ist aufgrund nachgewiesener Fremdzucker kein Honig, beginnende Kristallisation widerspricht Deklaration „Gold-Klar“. ¹⁰⁾	Guter Bergblütenhonig, ohne Wärme- und Altersschädigung.	Guter Bergblütenhonig, ohne Wärme- und Altersschädigung.	Guter Bergblütenhonig mit vergleichsweise langer Mindesthaltbarkeitsfrist.	Guter Bergblütenhonig, Herkunftsangabe „EG“ ist durch mikroskopische Untersuchung nicht überprüfbar.	Herkunftsangabe „EG“ ist durch mikroskopische Untersuchung nicht überprüfbar, übertriebene Werbeaussagen.
SENSORISCHE BEURTEILUNG	40 %	gut (2,0)	gut (2,0)	befried. (3,0)	befried. (3,0)	befried. (3,0)	befried. (3,0)	gut (2,0)	befried. (3,0)	gut (2,0)	gut (2,0)	gut (2,0)	gut (2,0)	gut (2,0)
Farbe		Rötlichbraun	Dunkelrotbraun	Hellbraun	Gelbbraun	Gelbbraun	Braungelb	Dunkelrotbraun	Gelbbraun	Hellgelb	Hellgelb	Hellgelb	Hellgelb	Hellgelb
Konsistenz		Dickflüssig	Dickflüssig	Flüssig mit beginnender	Dickflüssig mit beginnender	Dickflüssig mit beginnender	Dickflüssig mit Kristall	Flüssig	Flüssig mit beginnender	Feincrmig	Feincrmig	Feincrmig	Feincrmig	Feincrmig



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European Community Legal requirements



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Bees produce honey from plant sources



but



HONEY = ANIMAL PRODUCT

⇒ *legislation according to animal products*



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EC Directives and Regulations concerning Honey

- Honey Directive 2001/110/EC
- Regulation 470/2009 (Residues of pharmaceutical active substances)
- Regulation 37/2010 (MRLs of pharmaceutical active substances)
- Regulation 396/05 amended by 149/2008 (Pesticides)
- Regulation 178/02 (Food Safety)
- Regulations 852/04, 853/04 and 854/04 (Hygiene)
- Directive 96/23/EC (Monitoring Programme)
- Decision 2010/327/EC (List of Third Countries)



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Council Directive 2001/110/EC relating to honey

lays down the definition and composition of honey

Art.1 Where the Directive shall apply to (Annex I)

Which requirements the products shall meet
(Annex II)



Annex I

1. Definition

Honey is the natural sweet substance produced by ***Apis mellifera*** bees from the nectar of plants or from secretions of living parts of plants or excretions of plant-sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in honeycombs to ripen and mature.

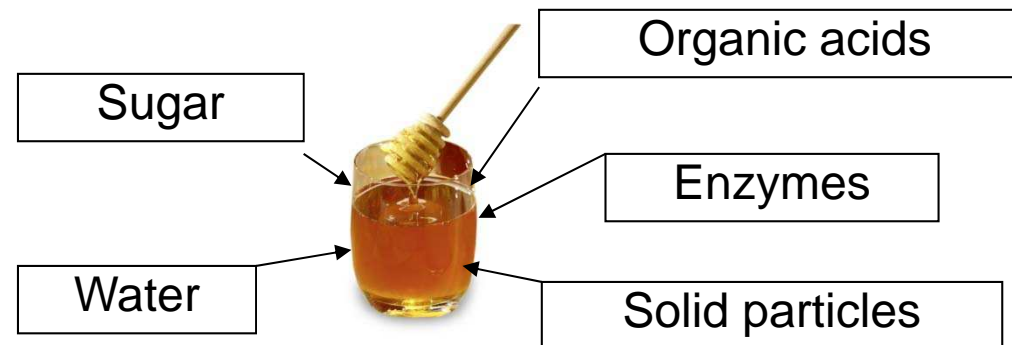




Annex II - Composition Criteria of Honey

Honey consists essentially of different sugars, predominantly fructose and glucose as well as other substances such as organic acids, enzymes and solid particles derived from honey collection

..., honey shall not have added to it any food ingredient (...) nor shall any other additions be made other than honey.





Annex II, cont.

Honey must meet specific composition criteria on:

1. Sugar content
 - Fructose and glucose content (sum)
 - Sucrose content
2. Moisture content
3. Water-insoluble content
4. Electrical conductivity
5. Free Acidity
6. Diastase activity and hydroxymethylfurfural content (HMF)



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Residues





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Regulation (EEC) No 470/2009

laying down Community procedures for the
**establishment of residue limits of pharmacologically
active substances in foodstuffs of animal origin,
repealing Council Regulation (EEC) No 2377/90 and
amending Directive 2001/82/EC of the European
Parliament and of the Council and Regulation (EC) No
726/2004 of the European Parliament and of the
Council**



Regulation (EEC) No 470/2009

Objectives

- Harmonise control standards for certain residues in food (avoiding divergent control reference points in different Member States)
- Integrate on a separate Commission Regulation (37/2010) the rules (MRLs, conditions of use, prohibitions) relating to individual substances, which have been in the 4 annexes of 2377/90

Art. 1 Subject matter and scope

To establish:

- the maximum concentration of a residue of a pharmacologically active substance (**MRL**) which may be permitted in food of animal origin (maximum residue limit);



New Elements of the Regulation:

Art. 14 - Classification of pharmacologically active substances

- a) a maximum residue limit (MRL);
- b) a provisional maximum residue limit;
- c) the absence of the need to establish a maximum residue limit;
- d) a prohibition on the administration of a substance.



New Elements of the Regulation:

Article 18-20: Reference points for action (RPA)

- When it is deemed necessary in order to ensure the functioning of controls of food of animal origin imported the Commission may establish **reference points for action** (RPA) for residues from pharmacologically active substances
 - RPA's could only be established in case no MRL exists for the respective substance (e.g. Chloramphenicol, Nitrofurantoin)
- RPA's are the practical ,zero'-tolerance



Reference points of action (RPA)

- The reference point for action should take into account the lowest residue concentration which can be quantified with an analytical method validated in accordance with Community requirements. (Community reference laboratory (CRL) according to 882/2004)
- **Recommendations** to the laboratories for analytic methods for honey:
 - Nitrofuranes 20 ppb
 - Tetracyclines 20 ppb
 - Streptomycine 40 ppb
 - Tylosine 20 ppb
 - Sulphonamides 50 ppb

Not to be considered as RPA's or legally binding!



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New Elements of the Regulation:

Art. 5 Extrapolation

- In case of existing MRLs for other species these should be considered by the Agency when carrying out scientific risk assessments and risk management recommendations.



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Regulation (EEC) No 37/2010

on pharmacologically active substances and their classification regarding maximum residue limits

Lists in an alphabetical order all pharmacologically active substances and their classification regarding maximum residue limits including their therapeutical classification



Annex I

Combines the former annexes I to III of 2377/90:

Allowed substances

Different types:

- Without MRL
 - Without restriction
 - With restriction - on application
 - on homeopathic veterinary medicinal products
- With MRL
 - MRL varies on species
 - MRL varies on target issue or product (e.g. liver, muscle, milk...)



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Allowed substances for bees according to Annex I

	MRL	Target tissue
Amitraz (Apivar)	200 µg/kg	honey
Coumaphos (Perizin)	100 µg/kg	honey
Flumethrine	no MRL required	
Oxalic acid	no MRL required	
Tau-Fluvalinate (Apistan)	no MRL required	
Lactic acid, Phenol, Thymol:	allowed for all food producing species, MRL not required	



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Annex II

Equals Annex IV of 2377/90

Prohibited substances

Aristolochia spp. and preparations thereof

Chloramphenicol

Chloroform

Chlorpromazine

Colchicines

Dapson

Dimetridazol

Metronidazol

Nitrofurane metabolites (including Furazolidone)

Ronidazol



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Third countries

- Some substances, not allowed in the treatment of bee diseases in the EU, were officially used in the third countries.
- There is no need to authorise new antibiotics, but it is necessary to control the residue of existing substances in honey.



New Antibiotics

However:

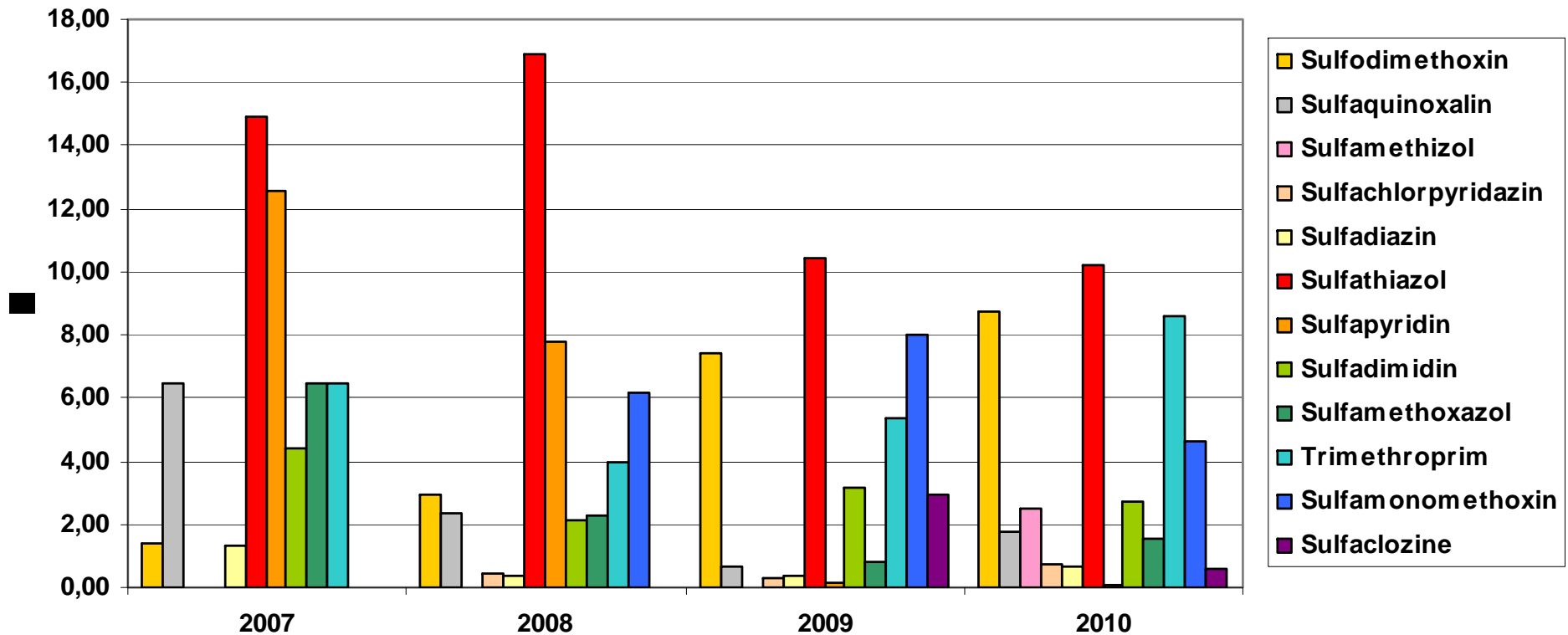
During the last years, more and more antibiotics were found in honey samples besides the classic ones

These are e.g.:

- Tylosin
- Dapson and Trimethoprim
- Fluoroquinolones like e.g. Enrofloxacin, Norfloxacin
- Groups like Macrolides e.g.: Erythromycin, Lincosamide, β -Lactam antibiotics and Penicillines



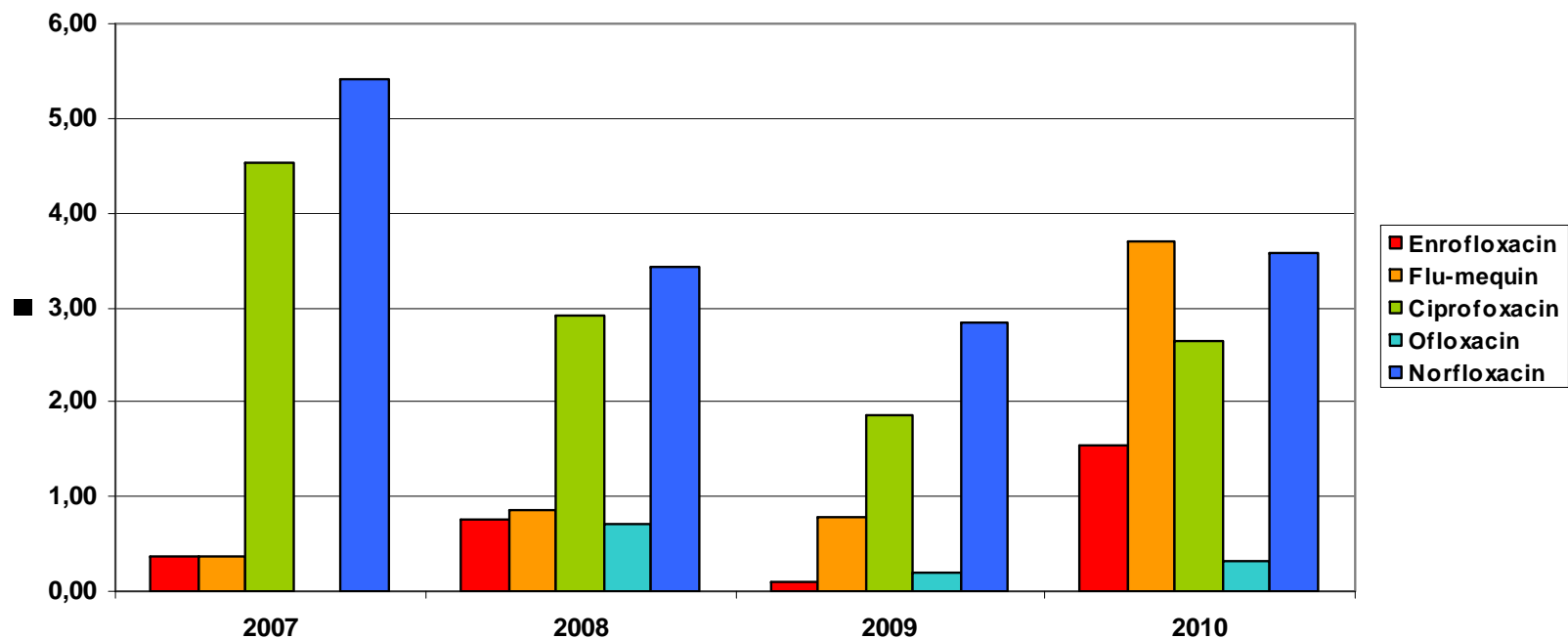
Sulfonamides - Distribution of positive findings





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Fluoroquinolone - Distribution of positive findings





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Pesticides



Insecticides

Fungicides

Herbicides



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Regulation (EC) No 396/2005

The regulation establishes:

- the maximum quantities of pesticide residues permitted in products of animal or vegetable origin intended for human consumption
- They include:
 - maximum residue levels (MRLs) specific to particular foodstuffs (Annex II, III and IV)
 - a general limit that applies where no specific MRLs has been set.



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**The maximum pesticide residue level in foodstuff “by default” is
10 µg/kg
i.e. in all cases where no MRL has been set.**

MRLs for all substances and all products can be found:

http://ec.europa.eu/sanco_pesticides/public/index.cfm



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Food Safety





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Regulation (EC) 178/2002

laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety



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Regulation (EC) 178/2002

- Considers necessarily ***all aspects of the food production chain*** as a continuum including the production of animal feed in order to ensure safety of food.

„From the farm (bee hive) to the table (honey pot)“





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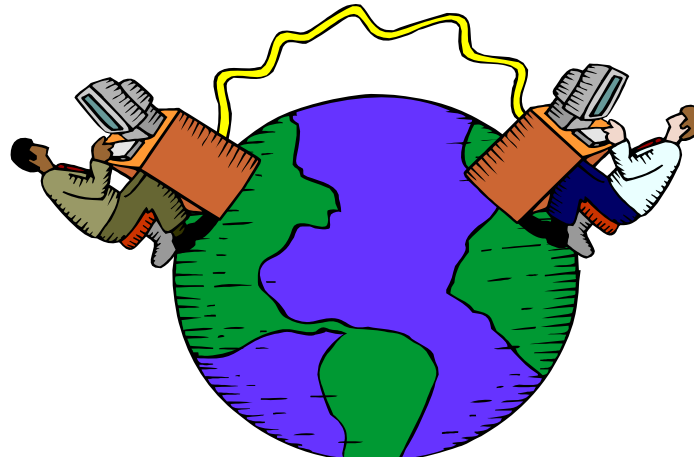


***What happens if the use of forbidden substances
and/or exceeded MRLs are detected and published?***



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EC Rapid Alert System





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Rapid Alert 2008 on bee products

Products with reported residues of veterinary drugs

Product	Alert	Informations
Honey	3	34
Royal Jelly	0	1
total	3	37

Source: Waren-Verein der Hamburger Börse e. V.

Hygiene





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Regulations on Hygiene

In 2004 the following regulations were set into force:

- 852/2004 Food hygiene in general
- 853/2004 Specific requirements for food of animal origin
- 854/2004 New Requirements for veterinary official control for food of animal origin

All beforehand existing hygienic directives are not in force anymore!



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Regulation(EC) No 852/2004 on the hygiene of foodstuffs

laying down general rules for food business operators on the hygiene of foodstuffs

Main points:

- **Beekeeping** falls under the definition of **primary production** meaning that beekeepers are not required to implement procedure based on HACCP.
- Food business operators carrying out **any stage of production, processing and distribution of food after primary production** have to comply with the general hygiene requirements and have to have in place a HACCP system.



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EU Import Conditions - from third countries –



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Monitoring System



Basis for the import to
the European Union





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Council Directive 96/23/EC

on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/496/EEC and Decisions 89/187/EEC and 91/664/EEC



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Council Directive 96/23/EC

The Directive lays down:

- Guidelines for the residue control in animals and in their products.
- Detailed procedures to set up a National monitoring plan
- Details on sampling procedures
- The set of substances and groups of residues that must be monitored (Annex I)



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To be monitored in honey

Substances or group of substances to be monitored mandatory:

Forbidden substances:

- Chloramphenicol, Nitrofuranes

Antibacterial substances:

- Streptomycin, Sulphonamides, Tetracyclins, Tylosin



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To be monitored in honey

- Carbamates and pyrethroids
- Organochlorine pesticides incl. PCBs
- Organophosphorous pesticides
- Chemical elements



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Commission Decision 2010/327/EC

These non-EU countries fulfilled the criteria for residue monitoring plans for honey:

Argentina	El Salvador	Moldavia	Thailand
Australia	Ethiopia	Macedonia	Turkey
Brazil	Fr. Polynesia	New Caledonia	Taiwan
Belize	Guatemala	Nicaragua	Tanzania
Cameroun	Israel	New Zealand	Ukraine
Canada	Jamaica	Pitcairn	Uganda
Chile	Kyrgyzstan	Russia	USA
China	Mexico	San Marino	Uruguay
Cuba	Montenegro	Switzerland	Zambia
Croacia		Serbia	



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What happens if one country does not fulfil the requirements established by the EU?



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Consequences:

Example Vietnam

After a FVO inspection in January/February 2007
Vietnam was taken off the list of countries allowed to
deliver honey into the EU.
Embargo since 06.06.2007.



Consequences:

Example Vietnam,cont.:

Reason were e.g.:

- insufficient residue and veterinary medicine control system
- no national residue monitoring plan provided in the years 2004-2006
- official labs not capable of testing adequately
- application of veterinary drugs not allowed in EU
- insufficient follow-up of non-compliant results



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Criteria Influencing Honey Quality



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List of Contaminants in Honey and Related Quality Problems

ENVIRONMENT

Problem	Substance
Environmental pollution	Polycyclic Aromatic Hydrocarbons (PAC)
Radioactivity	Caesium
Pollen of GM plants in honey	Genetically Modified organism (GMO)
Herbicides (e.g. by farmers)	Chloro-Pesticides, Phosphoric acid esters
Toxic plant metabolites	Pyrrolizidine Alkaloids (PA)



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Pyrrolizidine Alkaloids (PA)

- PA are secondary plant metabolites
- PA are formed by more than 6000 plant species (approx.)
- PA are toxic to the liver
- PA show cancerogenic properties



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Plants containing PA used by Bees

*Senecio
madagascariensis*



© Quality Services International

*Eupatorium
macrocephala*



© Quality Services International

*Echium
plantagineum*



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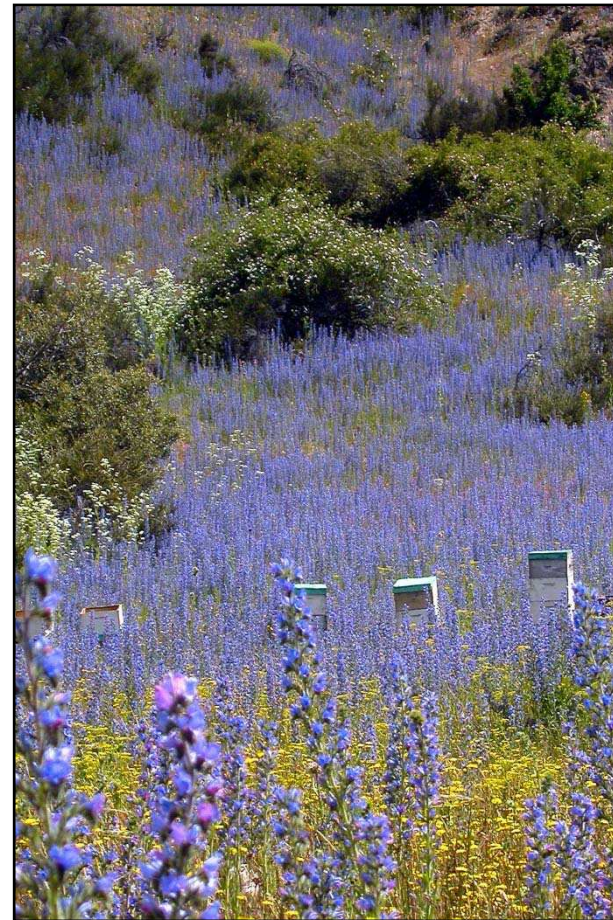
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Beehives location in Argentina



© Quality Services International

Beehives surrounded by
Echium vulgare in Argentina.



© Quality Services International

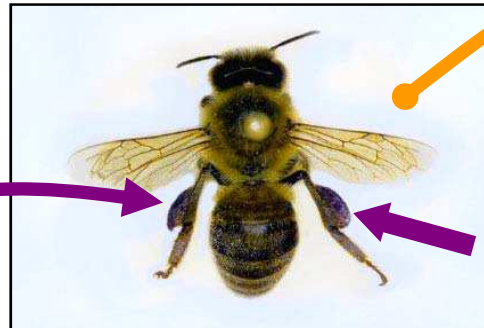
PA Transfer

*Echium
plantagineum*



© Quality Services International

Echium „Bee Pollen“



© Boppré et al. 2008



© Honigverband e.V.



PA-Limits

Currently there are no official limits for PA in honey!

PA-limit for phytopharmaca in Germany:

- 1 μg PA per day (consumption ≤ 6 weeks)
- 0,1 μg PA per day (consumption > 6 weeks)

This means for honey:

PA per 20 g Honey (1 Serving)

20 g Honey Consumption per day/PA-conc. **≥ 50 ppb (0.05 mg/kg)**

→ Exceedance of 1 μg PA per day

20 g Honey Consumption per day/PA-conc. **≥ 5 ppb (0.005 mg/kg)**

→ Exceedance of 0.1 μg PA per day



PA in non-EU-Honey

Origin	Samples total	Samples PA-pos. [%]	PA-conc. PA-pos. Honeys		Ø-Conc. PA-pos. Honeys	Ø-Conc. all Honeys
			min	max		
Argentina	404	66	1	555	52	34
Mexico	520	21	1	472	32	7
Brazil	94	74	3	288	49	37
Uruguay	128	100	9	423	98	98
Chile	105	89	1	388	45	40
China	20	0	-	-	-	-
India	14	21	42	74	53	11
Cuba	31	74	3	97	34	25
El Salvador	19	89	5	275	89	79

(Concentration in ppb, origin verified by pollen analysis)



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PA in Consumer Product

Consumer Product = Honey available in shops

Usually a mixture of EC/Non-EC Countries

In total **482** samples were analysed

97% PA-positive

PA-Concentration ranges from **1 ppb** to **209 ppb**

Average PA-concentration is **25 ppb**



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List of Contaminants in Honey and Related Quality Problems

BEEKEEPING:

Problem	Substance
Bee Pharmaceuticals	licensed products, non-licensed products
Preventive Pharmaceuticals	e.g. Tetracyclines, Streptomycine, Sulphonamides
Bee repellents	Phenol, Butyric Acid
Moth repellents	Dichlorobenzol, Naphtalene



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List of Contaminants in Honey and Related Quality Problems

HARVEST, STORAGE, PROCESSING:

Problem	Substance
Microbiology	Toxins, pathogenic germs, yeast
Fermentation	Yeast
Heavy Metals (e.g. by drums)	Lead, Cadmium
Ultrafiltration (to remove contaminants)	lack of pollen
Adulteration	Sugar cane, corn-sirup, rice-sirup



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Honey Adulteration

- Feeding of sugars to bees
- Addition of sugars to honey
- Addition of pollen
- Addition of filtered honey



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Possibilities to detect foreign sugars in honey

- sugar profiles
- $^{13}\text{C}/^{12}\text{C}$ -isotope ratio mass spectrometry (IRMS)
- LC-IRMS
- detection of foreign invertase



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IRMS

- established as AOAC Official Method 988.12
- Carbon isotope values of honey and honey protein are compared
- Nectarious plants: C3-sugars
Sugar cane, corn syrup: C4-sugars

Plant Origin	Examples	range $d^{13}C$ values [‰] _{VPDB}
C4-Plants	sugar cane corn	-10 up to -12
C3-Plants	beet sugar rice	-22 up to -27



QSI-Results of IRMS-measurements

- Since 2006 a continuous **slight increase** in the number of adulterated samples could be detected. In 2009 more than 12% of the samples analysed were adulterated.
- More and more also **positive differences** between protein and honey of $> +1.0$ were observed.
It is assumed, that positive difference are due to adulteration with C3-plants like rice- or beetsugar-sirup.

QSI will publish the research results in the near future.



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Why do we need quality control of honey ?

- Honey is a natural product
- Honey is a pure product
- This unique quality of honey must be preserved





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Thank you for your attention!

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