Chapter 24

Toxicological aspects and the sustainability factor in Brazilian beekeeping

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ABSTRACT
Brazilian legislation conceptualizes honey as the "food product produced by honey bees, from the nectar of flowers or secretions from living parts of plants or from excretions of plant-sucking insects that are on living parts of plants, which bees collect, transform, combine with specific substances of their own, store and mature in the honeycombs. The term "sustainability" is derived from the word sustainable (latin "sus-tenere") which defines the ability to sustain or support certain conditions. Currently, it has been widely used in socioeconomic and environmental issues, mainly. Studying toxicological aspects in Brazilian beekeeping united with sustainability was the objective of this work.

Keywords: Beekeeping, Sustainability, Toxicological.

1 INTRODUCTION

According to Anacleto et al. (2009), the characteristics of honey, such as aroma, color and taste, depend both on the composition of the nectar of the plant species (flowering of geographical regions) and on the species of the bee that produces it, being the climate, soil and the form of management by the beekeeper factors that cause minor effects on its characteristics (FELSNER, 2001).

According to LIANDA (2009), the chemical composition of honey is defined as a complex mixture of carbohydrates, enzymes, acids, amino acids, minerals, aromatic substances, vitamins, pigments, waxes and pollen grains. And, more broadly , it can be said that honey is composed of water (17%), glycides (80%) and other substances (3%), such as enzymes [(invertase, amylase (diastasis) and glucose oxidase)], amino acids (the most abundant proline), organic acids, flavonoids and mineral matter.

According to Almeida-Muradian (2009), honey is the product of the best known beekeeping and marketed in the world, being all the products of the hive (honey, bee pollen, royal jelly, propolis, beeswax and apitoxin) registered with the Ministry of Agriculture, Livestock and Supply (MAPA).

China is the largest honey producer in the world, although the product does not have good quality, according to the Brazilian Confederation of Beekeeping (CBA, 2013). The United States is in second place, followed by Argentina in third. Brazil, according to SEBRAE (2012), is in eleventh place, and fifth, as an

exporter. In 2011, Brazil exported more than 20,000 tons of honey, representing an increase of more than 24% compared to 2010 in values, and an increase in net weight of more than 18%. However, in August 2012, when compared to the export of this product in the same period of 2011, there was a drop of about 70% in value and 68% in net weight.

This growth in Exports of Brazilian Honey, until 2011, occurred after the international embargo with the European Community, which occurred in the years 2006 to 2008, due to the allegation of non-compliance with sanitary requirements in relation to the control of pesticide residues and veterinary drugs (PAULA, 2008). From this event, there was a joint effort by beekeepers and institutions to produce quality food, free of antibiotics and providing food security (Al-WAILI et. Al. 2012). The decrease observed from August 2012 was due to the period of great drought in that period, followed by intense and heavy rains that washed the nectar of flowers, thus decreasing productivity (SEBRAE, 2013).

In Brazil, honey is mainly produced by Africanized bees that, due to its genetic characteristics, dispenses with the use of antibiotics and pesticides, such as acaricides and fungicides. In some Brazilian regions, according to embrapa meio-norte researchers (Rangel, 2011), honey is recognized worldwide as a food free of toxic products and, due to this worldwide recognition, honey produced in Brazil is sought worldwide. However, in other countries, Krupke et al (2012) and Blacquière et al (2012), presented studies showing the presence of agricultural pesticides present in bee populations, which in addition to compromising the health of hives and their productivity, the presence of this contaminant may also offer a health risk consumer.

2 DEVELOPMENT

2.1 BRAZILIAN LEGISLATION ON TRACE ELEMENTS IN HONEY

With the objective of defining safe levels in relation to the presence of toxic substances in samples of meare and other foods, the Ministry of Agriculture, Livestock and Supply (MAPA), through Normative Instruction No. 42 of December 20, 1999 (Brazil, 1999), issued the so-called National Waste Control Plan on Animal Products and, in May 2009, through Normative Instruction No. 14, the Program for The Control of Waste and Contaminants in Meat (Beef, Poultry, Pork and Equina), Milk, Honey, Eggs and Fish. In this last instruction, Annex IV refers to the Program for The Control of Residues and Contaminants in Honey (PCRN)(BRASIL, 2009).

Table 1 shows the maximum concentration of some metals in honey, allowed by Brazilian legislation, according to Ribeiro (2010).

Table1: Maximum concentration allowed by the Brazilian Legislation of some metals present in mes.

	MAXIMUM PERMITTED CONCENTRATION (µg.g-1)			
Elements	Dec. 55871/65	Port. 11/87	Port. 685/98	IN 9/14
Arsenic (As)	1,0	ND	1,0	0,5
Cadmium (Cd)	1,0	ND	ND	0,5
Lead (Pb)	0,8	ND	ND	0,5
Copper (Cu)	30,0	ND	10,0	ND
Chromium (Cr)	0,1	0,1	ND	ND
Mercury (Hg)	0,01	ND	ND	0,5
Nickel (Ni)	5,0	ND	ND	ND
Selenium (If)	0,05	ND	ND	ND
Zinc (Zn)	50	ND	ND	ND

Dec. 55871/65 - Decree No. 55871/65 (BRASIL, 1965)
Port. 11/87 - Ordinance No· 11/87 (BRASIL, 1987) Port. 685/98 - Ordinance No. 685/98 (BRASIL, 1998)
IN 14/09 - Normative Instruction No. 14/09 (BRASIL, 2009) ND = Not defined by Legislation
Source: Ribeiro (2010) - Modified

In addition to traces of heavy metals, the PNCR also cites other contaminants, among them , antibiotics (Penicillin, Chloramphenicol, Streptominica, Tetracycline, Erythromycin, Neomycin, Oxytetracycline, Chlortetracycline); Sulfonamides (Sulfadimetoxin, Sulfametazin, Sulfatiazol, in addition to other drugs (Nitrofurazone and Furazolidone)(BRASIL, 2007).

In Table 2, Pittella (2009) demonstrated the maximum limits of antibiotic residues allowed in honey, according to the Brazilian Legislation, as well as the number of trials performed and the techniques used in the study conducted in 2009.

Table 2: Maximum Limits of Antibiotic Residues Allowed by Brazilian Legislation.

Group	Analyt	Technique	LQ (µgKg/L)	LMR/NA* (µg/kg/L)	No Test Items
Antimicrobials	Chlortetracycline (a) Oxytetracycline (a) Tetracycline (a)	HPLC-UV	25	200	60
	Sulfatiazole (b) Sulfametazin (b) Sulfadim etoxin (b) Sulfadiazine Sulfaquinoxaline Sulfaclorpyridazine	HPLC-UV	25	100	60
	Nitrofurazone Furazolidona Furaltadona Nitrofurantoin	LC/ MS-MS	0,5	1(1)*	30
	Tylosin	LC/ MS-MS	0,5	10	10

(a) MRL refers to the sum of all tetracycline
(b) The MRL refers to the sum of all Sulfonamides (*) NA - Level of action
HPLC - UV - Liquid alpha efficiency chromatography and visible ultraviolet detector LC/MS-MS - Liquid chromatography coupled to tandem mass spectrometry Source: Normative Instruction No. 9 of March 30, 2007. MAP. Pittella (2009) - Modified

This same Normative Instruction No. 9 of the Map also includes pesticide residues, such as another class of contaminants in medes and provides, according to Pittella (2009), the execution of analyses for the detection of these contaminants as well as the Maximum Residue Limit (MRL) for various types of halogenated, organochlorinated compounds, carbamates, pyrethroides and organophosphates in mes.

In Table 3, Pittella (2009) demonstrates the National Honey Waste Control Plan (PNCR-2007) containing, in addition to the number of tests performed and the techniques used, the Maximum Residue (MRL) and Quantification Limits (QS), recommended by the IN in question.

Table 3: Limits Maximum from Waste (MRL) e Limits from Quantification (LQ) from Waste from Pesticides Permitted by law Brazilian.

Group	Analyt	Matrix	Technique	LQ (µg/kg OR µg/L)	LMR/NA* (µg/kg or µg/L)	In Items test
Compounds Halogenated And Organochlorinated	Aldrin	Honey	CG/EM	10	10	15
	Alpha-Endosulfan			10	10	
	4.4-DDE			10	10	
	4.4-DDD			10	10	
	4.4- DDT			10	10	
	Dodecachlor			10	10	
	Endrin			10	10	
	Iprodione			50	50	
	Tetradifone			20	20	
	Captana			50	50	
	Liudane			10	10	
	Vinclozolin			20	20	
Carbamates And Pyrethroides	Permethrin	Honey	CG/EM	64,6	64,6	15
	Cyfluthrin			44	44	
	Fenpropatrin			10	10	
	Deltamethrin			33,8	33,8	
	Carbofuran			82	82	
	Carbaril			37	37	
Organophosphates	Pyriphos Methyl	Honey	CG/EM	36	36	30
	Chlorpyrifos			24,3	24,3	
	Dimetoate			20	20	
	Dissulfoton			10	10	
	Paration			36,9	36,9	
	Fenamifós			17,1	17,1	
	Terbuphos			13	13	
	Profenofós			36	36	

LQ - LMR quantification limit - Maximum residue limit (*) NA - Level of Action

CG-MS – Gas chromatography coupled to mass spectrometry Source: Normative Instruction No. 9 of March 30, 2008. MAP Source: Pittella (2009) - Modified

2.2 ANALYSIS OF RESULTS

Sustainability is a well-known word in agriculture since the 19th century, but has been gaining prominence since the 1980s and 1990s with the issue of social concern in relation to the environmental issue.

According to Silva et al (2008), since the Stockholm Conference in 1972 society began to worry also about the socio-environmental issue in issues related to world development versus widespread degradation of the environment and natural resources. However, even after all the moves that have occurred around the concern of sustainable practice such as the creation of the World Commission on Environment and Development (CMMAD) in 1983 by the United Nations (UN), and the United Nations Conference on Environment and Development in Rio de Janeiro, in 1992, it is observed that the attention of managers of the numerous associations created with the objective of making sustainability, both in the beekeeping sector and in other sectors, an emerging factor capable of integrating economic growth, with social development and environmental protection, still remains much more focused on the economic issue than in social and environmental environment.

Silva et al (2008), explains in their study that, although beekeepers have individual concern so far in relation to environmental and social issues (e.g. , afforestation of beekeepers' properties, donation of honey plants to schools, preservation and environmental awareness , the donation of beeproducts to entities, as well as transmitting to society the benefits of bee products for public health in addition to the importance of bees in the environmental context), they become associated, in the most often , the various class associations of the beekeeping sector with the intention of acquiring space and greater profit in the economic market.

3 FINAL CONSIDERATIONS

Beekeeping is, according to Both et al (2009), one of the only activities, among the numerous existing production processes, which presents better socio-economic and environmental conditions for the sustainability process, because it generates employment and consequently income for producers (beekeepers); decreases the rural exodus and, beekeeping production is linked to the regeneration of natural vegetation (withdrawal from nectar, pollination etc). However, with the progress of agricultural processes (agriculture, livestock, deforestation, among others) there is a great fall in bee production, since, in most cases observed, beekeepers have great difficulties for the development of beekeeping, such as the lack of organization and programs for the development of producers; lack of information on the use of veterinary antibiotics (e.g. pesticides among other products, which can lead to both the death of honey bees and contamination of the bee product.

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