

# MICROBIOLOGICAL QUALITY OF POLISH HONEY

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## Abstract

Two hundred and forty-five samples of honey representing different botanical types were microbiologically tested for total number of aerobic bacteria, *Salmonella* sp., anaerobic bacteria, yeasts, and moulds. The samples presented different level of microbiological contamination. Total number of aerobic bacteria varied from  $1.0 \times 10^1$  cfu/g to  $7.5 \times 10^4$  cfu/g. *Salmonella* sp. was not detected in any of the 25 g samples. Anaerobic spore forming bacteria were detected in 14.3% to 36.4% of samples, depending on the type of honey. Number of yeasts and moulds was low and only sporadically exceed  $1.0 \times 10^2$  cfu/g.

**Key words:** honey, microbiological quality, Poland.

Honey is usually considered as natural, healthy and clean product. Physico-chemical properties of honey, such a low water activity and high sugar concentration prevent the growth or even survival of different types of bacteria. However, honey is not sterile. Primary sources of microorganisms in honey may be pollen, the digestive tract of honey bees, soil, water, air, and nectar. These natural sources are very difficult to control. Secondary sources are closely connected with hygiene of processing, handling, and storage of honey. Different microorganisms were isolated from honey. Anaerobes are reported as the predominant microflora, including *Clostridium botulinum*, which is responsible for causes of infant botulism (1-3, 7, 9, 14, 15, 24, 25, 27). Several species of *Bacillus* sp. are also detected in honey (6, 12, 13, 17, 26). Other significant groups of microbes are yeasts and moulds, responsible for fermentation and spoilage of honey (8, 11, 13, 16, 23, 26).

The aim of the study was the evaluation of the microbiological quality of different types of honey from Polish apiaries.

## Material and Methods

Two hundred and forty-five samples of unifloral (lime, buckwheat, acacia, rape) and multifloral honey purchased from Polish apiaries were tested. Total viable count of aerobic microorganisms per 1 g, presence of *Salmonella* sp. in 25 g, presence of anaerobic spore forming bacteria in 0.1 g, and number of yeasts and moulds in 1 g were investigated. The investigations were performed in accordance to PN EN

ISO standards (18-21). The results are summarised in Table 1.

## Results

Aerobic mesophilic bacteria were isolated from all samples of honey. Their number varied between  $1 \times 10^1$  and  $7.5 \times 10^4$  cfu/g. Mean values ranged from  $2.4 \times 10^3$  cfu/g for rape honey to  $6.7 \times 10^3$  cfu/g for acacia honey. *Salmonella* sp. was not detected in any of the samples. Spore forming anaerobic bacteria were detected in 14.3% of samples of acacia honey up to 36.4% of samples of rape honey. All analysed samples contained detectable levels of yeasts and moulds, but their number per 1 g was low. Only few samples showed more than  $1.0 \times 10^2$  cfu/g.

## Discussion

Many authors indicate, that total aerobic viable count in honey can vary between zero and tens of thousands per gram (6, 8, 14, 23). Iurlina and Fritz (6) tested 70 samples of honey from different parts of Argentina. Total viable count of aerobic bacteria did not exceed  $1.0 \times 10^3$  cfu/g in any sample. Kňazovická *et al.* (11) reported a mean value of  $1.4 \times 10^2$  cfu/g of the bacteria. Jo *et al.* (7) detected  $8.5 \times 10^1 - 4.5 \times 10^2$  cfu/g of the microorganisms. According to Omafuvbe and Akanabi (17), the mean number of aerobic bacteria in honey ranged from  $1.0 \times 10^3$  to  $5.0 \times 10^3$  cfu/g. Malika *et al.* (12) found that viable counts varied between  $1.0 \times 10^1$  and  $1.0 \times 10^2$  cfu/g.

**Table 1**  
The results of microbiological analysis of the different types of Polish honey

Botanical origin of honey	Total number of aerobes per 1 g		Spore forming anaerobes in 0.1 g (number of samples/percentage)	Number of yeasts and moulds per 1 g (range)
	mean	range		
Multifloral (n = 130)	4.4 x 10 <sup>3</sup>	1.0 x 10 <sup>1</sup> - 6.8 x 10 <sup>4</sup>	37/28.5	< 5.0 x 10 <sup>1</sup> - 3.3 x 10 <sup>3</sup>
Lime (n = 50)	5.0 x 10 <sup>3</sup>	1.0 x 10 <sup>1</sup> - 7.5 x 10 <sup>4</sup>	13/26.0	< 5.0 x 10 <sup>1</sup> - 8.0 x 10 <sup>4</sup>
Buckwheat (n = 40)	2.8 x 10 <sup>3</sup>	2.5 x 10 <sup>1</sup> - 1.5 x 10 <sup>4</sup>	13/32.5	< 5.0 x 10 <sup>1</sup> - 2.6 x 10 <sup>3</sup>
Acacia (n = 14)	6.7 x 10 <sup>3</sup>	2.5 x 10 <sup>1</sup> - 1.5 x 10 <sup>4</sup>	2/14.3	< 5.0 x 10 <sup>1</sup> - 2.5 x 10 <sup>2</sup>
Rape (n = 11)	2.4 x 10 <sup>3</sup>	2.5 x 10 <sup>1</sup> - 1.5 x 10 <sup>4</sup>	4/36.4	< 5.0 x 10 <sup>1</sup> - 2.0 x 10 <sup>2</sup>

In our results, some samples with extremely high level of microbiological contamination determined mean value aerobic viable count for all samples. In our investigations, *Salmonella* sp. was not detected in any of 245 samples. In the experiments performed by Snowdon and Cliver (23) and Iurlina and Fritz (6), *Salmonella* sp. was also absent in all samples of honey. Our results indicated that relatively high number of honey samples was contaminated by anaerobic spore forming bacteria. These microorganisms are a part of the normal flora of gastrointestinal tract of honey bees and may contaminate honey (4, 9).

Many sources indicate the potential risk connected with *Clostridium botulinum*, which is responsible for infant botulism. Spores of *Cl. botulinum* can survive in honey, but they are not able to produce toxins. In some cases infant botulism may be caused by honey ingestion. Because of the potential hazard honey should not be given to infants under one year of age (1-3, 14, 22, 25, 26).

The number of yeasts and moulds in our samples of honey was relatively low. Most of the samples were contaminated at level of 5.0 x 10<sup>1</sup> cfu/g. Sporadically, the number of yeasts and moulds exceeded 1.0 x 10<sup>2</sup> per g. Similar results were obtained by Snowdon and Cliver (23), Martins *et al.* (13), Káčaniová *et al.* (8), Jo *et al.* (7), Kňazovická *et al.* (11), and Malika *et al.* (12). In all cases the number of yeasts and moulds was lower than 1.0 x 10<sup>2</sup> cfu/g.

The microflora of honey is very various. For example, Tchoumboue *et al.* (26) isolated eight species of moulds, with *Candida* sp. as predominant. Olaïtan *et al.* (16) isolated from honey 16 species of bacteria, 13 species of yeasts, and 12 species of moulds. Martins *et al.* (13) reported the isolation of moulds: *Aspergillus*, *Penicillium*, *Mucor*, and yeasts: *Saccharomyces* and *Candida*. Káčaniová *et al.* (8) described 13 species of moulds. *Clostridium* sp. and *Bacillus* sp. were also often isolated (6, 7, 12-15, 22, 26). Four species of acetic acid bacteria from genus *Gluconobacter* were isolated from Thailand honey (10).

Bacteria are not able to multiply in honey. Their high number could indicate contamination during processing, handling, and storage. This should be controlled by good manufactory practices.

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