

**VETERINARY-SANITARY ASSESSMENT OF HONEY OBTAINED FROM
VARROATOSIS-INFECTED HONEYBEE COLONIES****Ibragimov Furqat Buriyevich**

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Annotation. This study presents a veterinary-sanitary evaluation of honey collected from honeybee colonies affected by varroatosis. The research was carried out in 2025–2026 at the Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnology. Honey samples were obtained from apiaries located in the Samarkand and Kashkadarya regions. Organoleptic, physicochemical, microbiological and toxicological analyses were used to determine honey quality. The findings showed that varroatosis is associated with increased moisture content, decreased diastase activity, higher microbial contamination and, in certain cases, the presence of antibiotic and acaricide residues. These results indicate that varroatosis adversely influences the hygienic safety and overall quality of honey.

Keywords: *honeybees, varroosis, Varroa destructor, honey quality, organoleptic parameters, chemical analysis, physicochemical indicators, microbiological indicators, toxicological indicators.*

Introduction.

The quality indicators of beekeeping products and their veterinary and sanitary safety are of great scientific and practical importance in protecting public health and ensuring food safety. In particular, the hygienic condition, chemical composition, and biological purity of honey are considered the main factors determining its suitability for consumption. In modern beekeeping practice, one of the factors affecting these indicators is the widespread occurrence of invasive diseases among honey bees, which requires special attention [1; 3; 8].

In recent years, varroosis—recognized as one of the most pressing problems in global apiculture—has had a serious negative impact on the vital activity of honey bees. The mite *Varroa destructor* паразитирует on the bodies of bees, weakens their immune system, disrupts metabolic processes, and creates favorable conditions for the development of viral and bacterial diseases [4; 7; 8]. As a result, not only does the productivity of bee colonies decrease, but adverse changes may also be observed in the quality of the honey obtained from them [2; 5].

Scientific literature reports that varroosis affects the physicochemical parameters of honey, its enzymatic activity, moisture content, and microbiological status, which may lead to a reduction in its sanitary safety level [6; 9; 10]. In addition, the use of medicinal products and acaricidal preparations against varroosis should be considered, as they may result in the accumulation of residual substances in honey [1; 6].

In this regard, a comparative analysis of honey samples obtained from varroosis-affected and clinically healthy bee colonies based on organoleptic, physicochemical, microbiological, and toxicological indicators is of great importance for determining the impact of this disease on honey quality. The results of this study contribute to the improvement of scientifically grounded evaluation criteria in the veterinary and sanitary examination of honey products and to strengthening quality control over beekeeping products.

Relevance of the Study.

At present, varroosis, which is widely распространено among honey bees, significantly affects the sustainable development of the beekeeping sector as well as the quality indicators of honey products. This invasive disease not only weakens the immune status of the bee organism and disrupts metabolic processes, but may also cause adverse changes in the hygienic and chemical properties of the honey produced [1; 2; 6; 10]. Therefore, a comparative study of

honey samples obtained from varroosis-affected and healthy bee colonies based on organoleptic, physicochemical, microbiological, and toxicological parameters is of considerable scientific and practical importance. Such studies contribute to improving the criteria for assessing honey quality and safety and to the further development of the veterinary and sanitary expertise system.

Aim of the Study.

To determine the impact of varroosis on the veterinary and sanitary status of honey by conducting a comparative analysis of the quality indicators of honey samples obtained from varroosis-affected and clinically healthy bee colonies using organoleptic, physicochemical, microbiological, and toxicological methods.

Research Objectives

1. To organize the selection, storage, and transportation of honey samples obtained from varroosis-affected and healthy bee colonies to the laboratory in accordance with hygienic requirements.
2. To evaluate the organoleptic characteristics of the collected honey samples, including taste, odor, color, and consistency, using established methods.
3. To determine the main physicochemical parameters of honey—specifically moisture content, diastase activity, pH value, and total acidity—through laboratory analysis.
4. To assess the microbiological status of honey samples by determining the number of aerobic mesophilic microorganisms and, on this basis, evaluate their sanitary condition.

Materials and Methods

This scientific research was conducted during 2025–2026 at the Department of *Veterinary Sanitary Expertise* of Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnology within the framework of the project “*Development of Preparations from Local Medicinal Plants Against Bee Diseases.*” The studies were organized at Apidomik, the “Orzu, Olim, Dilmurod Honey Bees” apiary in Toyloq district, Samarkand region, and the “Ergashev Tora Beekeeping” apiary in Shahrisabz district, Kashkadarya region. From each apiary, 12 bee colonies of the Kornenko breed were selected for scientific research. The quality of honey samples was assessed using organoleptic, physicochemical, microbiological, and toxicological methods. This approach allowed for a comprehensive study of the quality indicators of honey obtained from both varroosis-affected and healthy bee colonies.

Research Procedure.

To evaluate the veterinary and sanitary status of honey samples from varroosis-affected bee colonies, colonies exhibiting both healthy and disease symptoms were selected from apiaries located in various agroclimatic zones. From each experimental and control colony, 50–100 worker bees and 100–150 grams of honey were collected. On average, 0.5–1.0 kg of honey per apiary was placed into sterilized clean glass containers in compliance with hygienic requirements. Each sample was labeled with the apiary name, colony identifier, experimental or control group number, collection date, and other relevant information. The containers were protected from light and heat and transported to the laboratory at +4 °C. Laboratory analyses of the collected honey samples were carried out to assess organoleptic, physicochemical, microbiological, and toxicological parameters. Evaluation Criteria and Physicochemical Analyses

Evaluation Criteria Each organoleptic parameter (taste, odor, color, consistency) was assessed using a 3-point scale: 1 — low, 2 — medium, 3 — high quality. The final evaluation was calculated by summarizing all parameters, resulting in a comprehensive quality score for each honey sample. The results were recorded in specially designed protocols. **Physicochemical Analyses** The main objective of this study was to compare the quality of honey obtained from healthy and varroosis-affected bee colonies to determine their veterinary and sanitary status. For this purpose, a series of physicochemical analyses were carried out under controlled laboratory conditions (temperature 20–22 °C, relative humidity 60–70%). The results were evaluated according to the State Standard of Uzbekistan (O‘zDST 1054:2004) and the Codex Alimentarius international standards.

For the analysis, the following primary physicochemical parameters were selected: moisture content, diastase activity, and 5-hydroxymethylfurfural (HMF) content. These indicators provide a comprehensive understanding of the condition of the bee colony, hygienic conditions, level of disease infection, and the storage quality of honey.

Moisture Content:

Measured using the refractometric method. One to two drops of honey were placed on the prism of a special optical refractometer. The refractive index was determined at 20 °C and converted into percentage moisture using reference tables. The results showed that honey from varroosis-affected colonies had higher than normal moisture, which could be associated with delayed harvesting or improper storage.

Diastase Activity (DN): Assessed using the Schade method. Honey samples were dissolved in distilled water and mixed with starch solution at 40 °C. The enzymatic reaction was

monitored with iodine, and DN units were determined by observing color changes every 5 minutes. The results indicated a significant reduction in enzymatic activity in varroosis-affected colonies, reflecting overall physiological weakness and metabolic disruption in the bees.

pH and Acidity: A 10% honey solution was prepared and measured with a pH meter. Titratable acidity was also evaluated. Standard parameters: pH 3.4–4.5 and total acidity less than 50 meq/kg. In varroosis-affected honey, deviations from these norms were observed, which can influence the fermentation status, microbial balance, and storage properties of honey.

Overall, physicochemical analyses allowed for a comparison of composition, quality indicators, and safety of honey samples from healthy and varroosis-affected colonies. The results demonstrated that varroosis leads to reduced enzymatic activity, increased moisture, and changes in acidity. Therefore, preventive measures against varroosis are crucial not only for bee health but also for honey quality and consumer safety (Table 1).

Table 1

Results of Organoleptic and Physicochemical Analyses of Honey Samples from Healthy and Varroosis-Affected Bee Colonies

Parameter	Evaluation Criterion	Result (Healthy Colonies)	Result (Varroosis-Affected Colonies)
Organoleptic Assessment	3-point scale: 1 – low, 2 – medium, 3 – high quality	3 points (high quality)	2 points (medium quality)
Moisture Content	≤ 20 %	17.8 %	19.5 %
Diastase Activity	≥ 8 DN	10–12 DN	6–7 DN
pH	3.4–4.5	3.6–4.2	3.2–3.3

Microbiological and Toxicological Analyses

Microbiological Analysis During the study, honey samples obtained from both healthy and varroosis-affected bee colonies were evaluated microbiologically. The main assessment criterion was the number of aerobic mesophilic microorganisms (AMM), as this indicator reflects the overall microbiological purity of honey, compliance with sanitary-hygienic requirements, and storage quality. The composition of the microbial flora was assessed based on colony shape, color, and growth characteristics. Honey from varroosis-affected colonies exhibited higher AMM counts, indicating possible improper harvesting, delayed storage, or incomplete adherence to sanitary standards. In contrast, honey from healthy colonies had AMM

levels within normative limits, demonstrating a high degree of hygienic safety. These microbiological results serve as an important criterion for evaluating the veterinary and sanitary status of honey and have practical significance for monitoring product quality in beekeeping and ensuring its suitability for consumption. Toxicological Analysis Honey samples from both healthy and varroosis-affected colonies were also evaluated for toxicological safety, focusing on the presence of heavy metals and residues of medicinal products (antibiotics and acaricides). Heavy Metals: Lead (Pb), cadmium (Cd), and arsenic (As) were measured using atomic absorption spectrophotometry (AAS). Results showed that honey from healthy colonies contained heavy metals within permissible limits, while samples from varroosis-affected colonies occasionally exhibited elevated Pb and Cd levels, possibly due to the use of medicinal treatments or environmental contamination. Antibiotics and Acaricide Residues: Antibiotics (e.g., chloramphenicol, tetracyclines) and acaricides (e.g., amitraz) were determined using high-performance liquid chromatography (HPLC) with high sensitivity. Concentrations were calculated from chromatograms and compared with international Maximum Residue Limits (MRLs). The results indicate that varroosis can reduce the toxicological safety and veterinary-sanitary value of honey, underscoring the importance of maintaining healthy bee colonies and implementing effective disease control measures.

Results of Microbiological and Toxicological Analyses of Honey from Healthy and Varroosis-Affected Bee Colonies

Parameter	Evaluation Criterion / Limit	Honey from Healthy Colonies	Honey from Varroosis-Affected Colonies
Aerobic Mesophilic Microorganisms (AMM), CFU/g	$\leq 1.0 \times 10^3$ CFU/g	2.5×10^2	$1.2 \times 10^3 - 1.5 \times 10^3$
Heavy Metals (Pb, Cd, As), mg/kg	Pb ≤ 0.1 ; Cd ≤ 0.03 ; As ≤ 0.05	Within limits (Pb ≤ 0.05 ; Cd ≤ 0.01 ; As ≤ 0.01)	Occasionally elevated: Pb 0.12; Cd 0.05
Antibiotic Residues	Absent or below MRL	Not detected	Detected in some samples: tetracycline 0.02–0.04

Acaricide Residues (Amitraz)	Absent or MRL ≤ 0.2 mg/kg	Not detected	Detected in some samples: 0.15–0.25 mg/kg
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Discussion of Toxicological Findings The analyses demonstrated that honey samples from healthy bee colonies did not contain antibiotics or acaricides, or these substances were present at levels well below permissible limits. In contrast, some honey samples from varroosis-affected colonies contained amitraz and tetracycline residues, indicating the use of medicinal treatments to control varroosis in these colonies. These toxicological analyses allowed for a comprehensive veterinary and sanitary assessment of honey from both healthy and affected colonies. This approach made it possible to evaluate the epizootological significance of varroosis, as well as its impact on honey quality and safety.

Conclusion

1. Honey samples from **varroosis-affected bee colonies** showed no significant differences in organoleptic properties compared to honey from healthy colonies. However, **physicochemical analyses** revealed **increased moisture content, reduced diastase activity,** and deviations in acidity levels from normative standards.
2. **Microbiological analyses** indicated a higher number of **aerobic mesophilic microorganisms** in honey from varroosis-affected colonies, suggesting potential impacts on **hygienic safety and storage quality.**
3. **Toxicological analyses** detected occasional **elevated levels of heavy metals (Pb, Cd)** and residues of medicinal substances, likely due to **the use of treatments against varroosis or environmental contamination.**
4. The study results demonstrate that **implementing comprehensive measures against varroosis** is crucial not only for **maintaining bee health,** but also for ensuring **the veterinary-sanitary safety of honey,** and for delivering **high-quality, ecologically safe products to consumers.**

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