In-depth regional surveys record for each sample the geographic coordinates, altitude, surrounding land use, and potential anthropogenic influences (industrial plants, waste sites, intensive agriculture), together with harvest year and extraction methods, creating metadata needed to interpret elemental and quality differences (Bora et al., 2024). Such designs allow later use of multivariate statistics to relate honey quality patterns to mapped environmental drivers.

7.2 Comparison of honey quality indicators under different environmental conditions

Regional comparisons usually start from a core set of physicochemical indicators (moisture, pH, sugars, electrical conductivity) and extend to mineral profiles, potentially toxic elements and antioxidant traits. Multi-regional studies in Romania and Serbia have shown that contents of K, Mg, Na and microelements (Al, Cu, Fe, Mn, Ni, Zn, Se) vary significantly with both geographical and botanical origin, while toxic metals such as Pb and Cd may exceed safety limits in some polluted areas (Bora et al., 2024). Parallel assessment of pH, moisture, color and antioxidant activity across agroecological zones or climatic regions reveals systematic regional differences, with some zones producing darker honeys with higher phenolic and flavonoid contents and stronger antioxidant capacity (Smith et al., 2021).

In landscapes with known industrial or agro-industrial pollution, honey quality comparisons focus more explicitly on food safety and bioindicator functions. Surveys in historically contaminated Romanian regions found Pb and Cd concentrations consistently above international safety thresholds, with spatial analysis showing higher contamination at sites closer to former industrial facilities and along suspected atmospheric transport pathways (Shakoori et al., 2023). Other long-term or broad-scale datasets using honey as a recorder of environmental lead demonstrate that metal concentrations and Pb isotopic compositions differ between urban, rural, and agricultural settings, reflecting both local emissions and larger-scale legacy pollution (Awolu et al., 2025). Together, these comparative indicators reveal how divergent environmental conditions translate into distinct nutritional profiles, contaminant burdens and functional qualities of honey (Figure 2).

Figure 2 Comparative analysis of honey quality under different regional environmental conditions

Hangzhou Linan Hongjian Bee Breeding Family Farm utilizes the superior natural environment and high-quality honey crops in the area to produce high-quality honey with a good taste, which is highly welcomed by consumers (Figure 3).