indicate that bees collect pollen from relatively few species in early spring and late summer, but from many more taxa in mid-season, and that semi-natural habitats become especially important for maintaining pollen diversity at the end of the flowering season (Vîjan et al., 2023). Consequently, the timing and stability of nectar sources-defined by flowering cycles, habitat composition, and landscape management-play a central role in determining whether honeys are monofloral or multifloral and how consistent their botanical and quality attributes are across years and production environments.

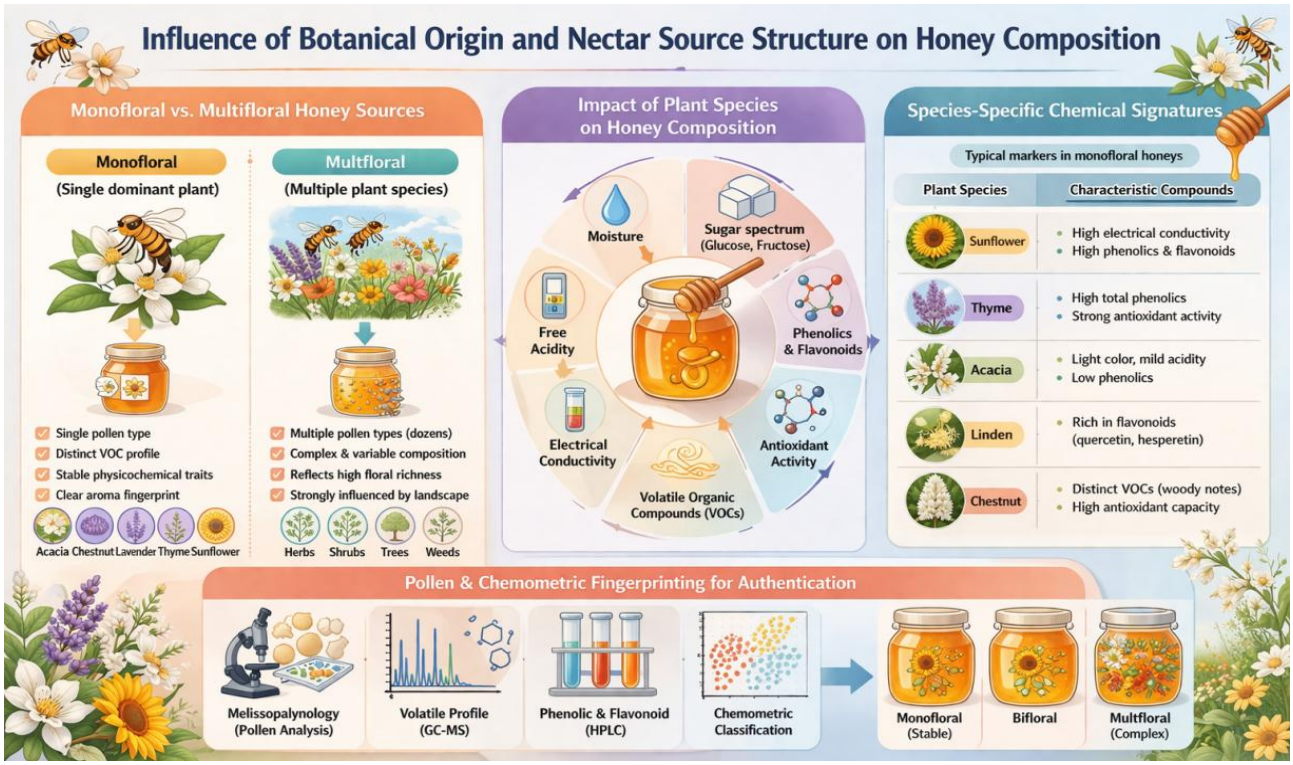

Figure 1 Influence of botanical origin and nectar source structure on honey composition and quality

5 Factors Related to Bee Populations and Foraging Behavior

5.1 Impact of bee breed differences on honey quality

Differences among bee species and breeds can modify the physicochemical and bioactive characteristics of honey by shaping which flowers are visited, how nectar is processed, and how honey is stored. Comparative work on Apis mellifera and stingless bees shows that bee type significantly affects moisture, free acidity, HMF, phenolic content, and antioxidant capacity of honey, with stingless bee honeys generally having higher moisture, higher acidity, and different phenolic profiles than A. mellifera honeys (Dupont et al., 2025). These interspecific differences are linked not only to floral choices but also to morphological and behavioral traits, such as body size, flight range, and preferred plant strata, which together define access to nectar sources and conditions of in-hive ripening (Dwarka et al., 2025).

A systematic meta-analysis further indicates that bee type (A. mellifera vs. various stingless genera) is a significant covariate explaining variability in phenolics, flavonoids, and several physicochemical parameters across countries and floral sources (Dwarka et al., 2025). Stingless bees often forage on smaller flowers and perform shorter flights than A. mellifera, and they store honey in cerumen pots rather than wax combs, introducing additional material and microenvironmental effects that can alter the final honey composition. These findings imply that breed or species composition of bee populations is a primary biological factor underlying regional patterns in honey quality, even under comparable environmental conditions (Dupont et al., 2025).

5.2 Foraging behavior and nectar collection efficiency

Foraging behavior determines which nectar and pollen resources are incorporated into honey, thereby influencing sugar profiles, micronutrients, and specialized metabolites. DNA metabarcoding and palynological studies show