postpartum lochia discharge (Zhang et al., 2018). Ethnopharmacological and pharmacological syntheses emphasize that these alkaloids exert uterotonic effects, improve uterine blood flow, and modulate platelet aggregation and vascular tone, linking them directly to relief of blood-stasis-type gynecological syndromes and prevention of thrombotic complications in the puerperium (Shang et al., 2014; Zhang et al., 2023). Leonurine additionally exhibits cardioprotective, neuroprotective, and anti-oxidative activities, which may benefit women with comorbid cardiovascular risk or stress-related menstrual irregularities. The recent elucidation of leonurine biosynthesis-highlighting arginine decarboxylase, UDP-glucosyltransferase, and serine-carboxypeptidase-like acyltransferase as key enzymes-creates opportunities to breed or engineer high-leonurine lines, thereby optimizing uterotonic and cardioprotective potential in gynecological formulations.

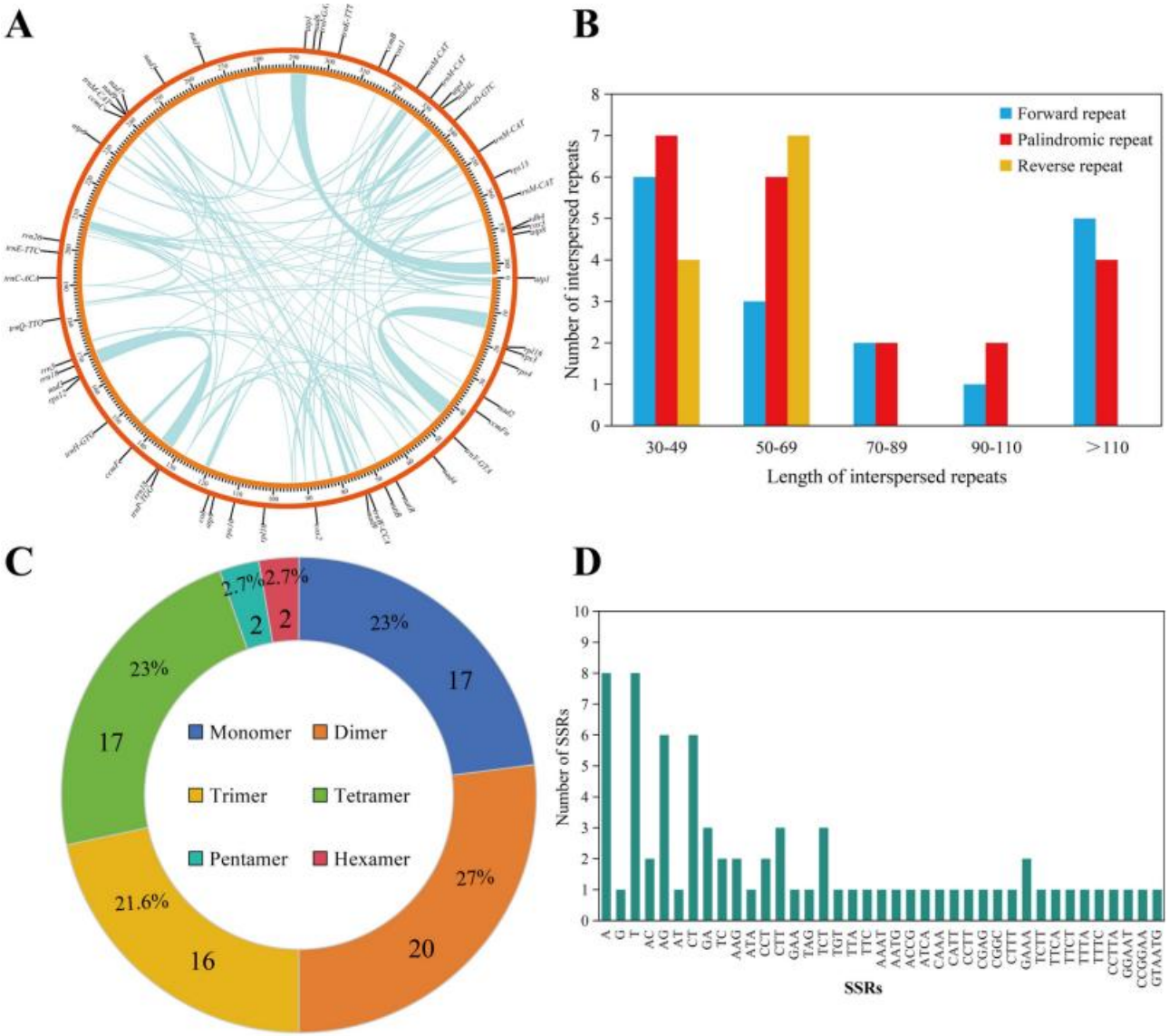

Figure 2 Repeat sequence analysis of the *L. japonicus* mt genome (Adopted from Hu et al., 2025)

Image caption: (A) The distribution of repeat sequences. The outer circle displays different genes. The blue inner arc indicates repeat sequences that are greater than or equal to 30 bp in length. (B) Histograms of lengths and classes of different DSRs. Different colors represent different types of DSRs. The x-axis and y-axis indicate the length and quantity of DSRs, respectively. (C) Proportion of different types of SSRs. Different colors represent different types of SSRs. (D) Statistical histograms of various SSRs. The x-axis displays different SSRs, while the y-axis shows the length of each SSR (Adopted from Hu et al., 2025)

3.2 Flavonoids and phenolic acids

Flavonoids and phenolic acids constitute a second dominant class of secondary metabolites in *L. japonicus*, widely distributed in aerial parts and readily enriched by polar extraction (Malave et al., 2020; Morais et al., 2023).