accumulation of peimine and related steroidal alkaloids changes accordingly. Comparative metabolomic and time-series metabolomic studies on related *Fritillaria* species have shown that peimine and peiminine mainly accumulate in bulbs and often reach relatively high levels at later developmental stages or shortly after aboveground withering, indicating that alkaloid enrichment is closely associated with bulb maturation (Figure 1) (Duan et al., 2022; Duan et al., 2023). From the perspective of biosynthesis, peimine may originate from cholesterol metabolism and involve the terpenoid backbone pathway and downstream steroid pathways. Cytochrome P450 enzymes and glycosyltransferases may participate in its structural diversification, but the complete enzymatic biosynthetic route remains to be further clarified (Nile et al., 2021; Shan et al., 2022; Liao et al., 2023).

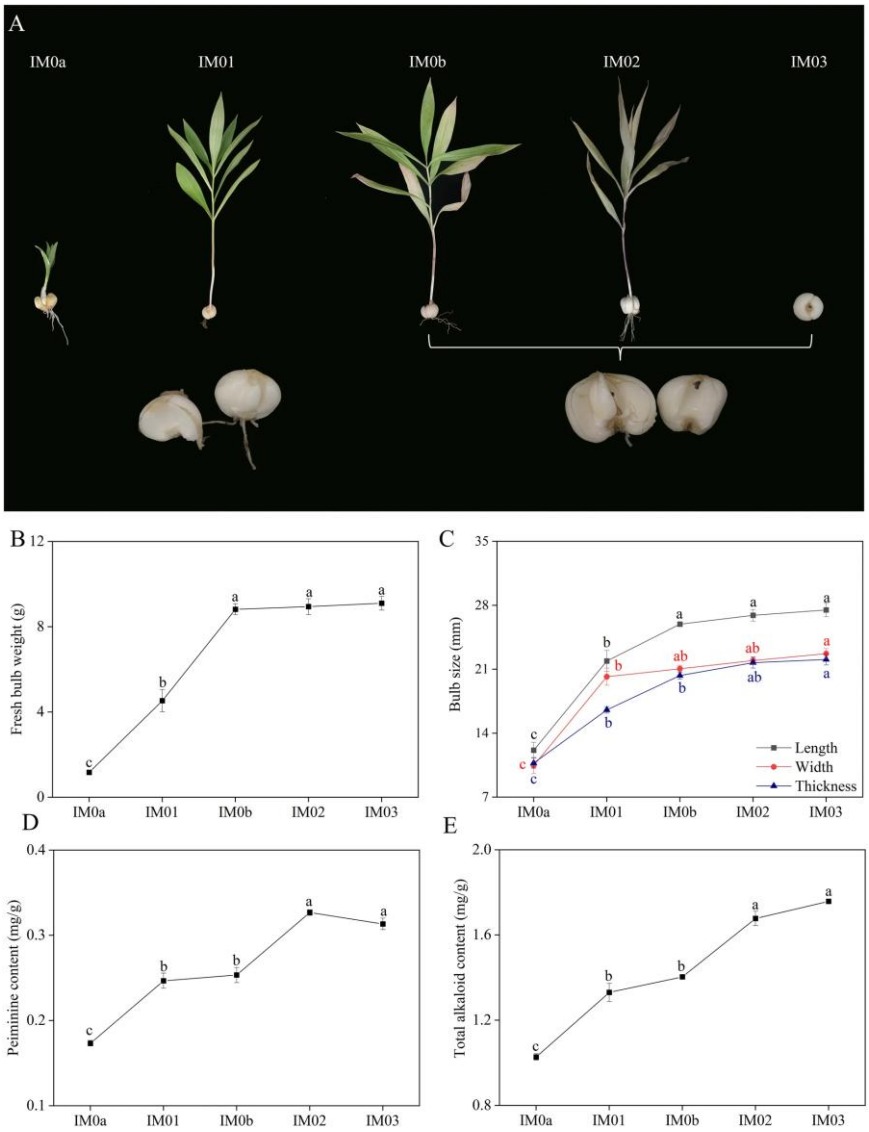

Figure 1 Dynamic phenotypic and biochemical variations in regenerated bulb development of *F. hupehensis* (Adopted from Duan et al., 2023)

Image caption: (A): Phenotypic changes in *(F) hupehensis* at five developmental stages; (B): Bulb size (length, width, and thickness) changes; (C): Details of changes in fresh bulb weight; (D): Details of changes in peiminine content; (E): Details of changes in total alkaloid content; All data in the Figure are represented as mean±standard error; Different letters in each system represent significant differences at $p<0.05$ (Adopted from Duan et al., 2023)

The accumulation of peimine and related steroidal alkaloids is sensitive to cultivation practices and environmental conditions. Studies have shown that, compared with less optimized treatments, organic fertilizer application and appropriate potassium supply under shading conditions can significantly increase peimine and peiminine levels in