

## Supplementary material

### **High-value bioconversion of ginseng extracts in betaine-based deep eutectic solvents for the preparation of deglycosylated ginsenosides**

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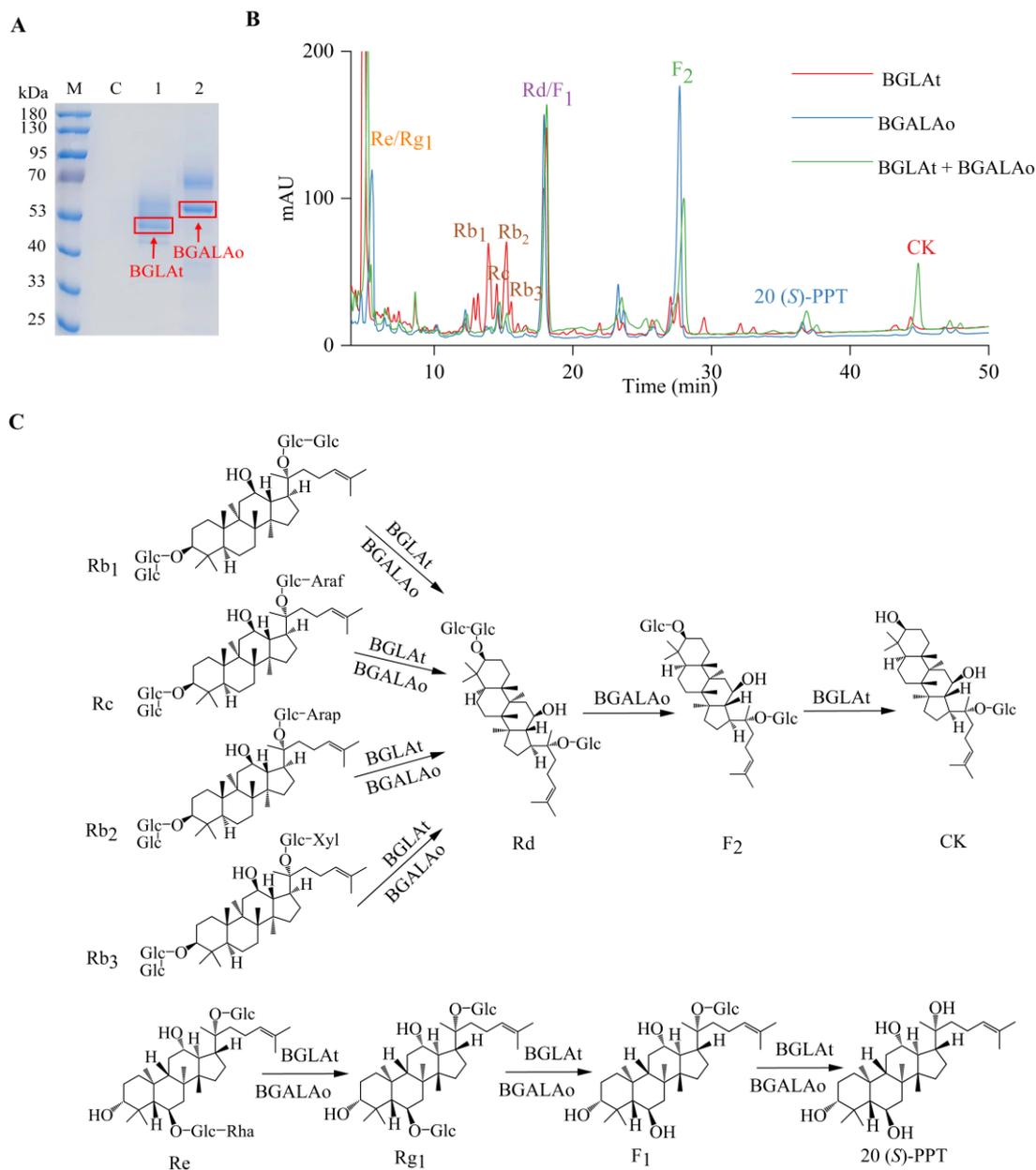
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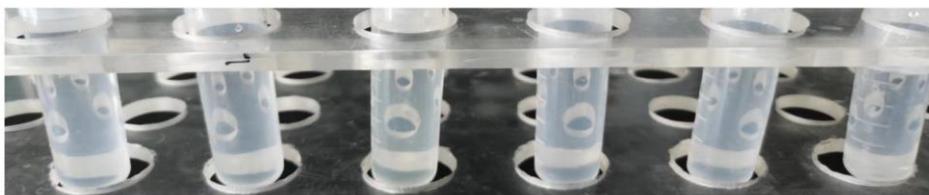
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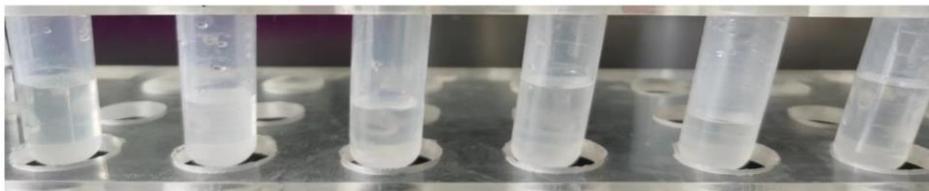


**Figure S1.** (A) SDS-PAGE analysis of the BGLAt and BGALAo. M, 25-180 kDa protein marker; C, acetate buffer (20 mM, pH 6.0); 1, BGLAt; 2, BGALAo. (B) HPLC analysis of samples of lyophilized enzymes (300 U/mL BGLAt, 170 U/mL BGALAo, and the combinatorial enzymes contained 300 U/mL BGLAt and 170 U/mL BGALAo) reacted with the final concentration of 5 g/L GE in 20 mM acetate buffer (pH 6.0) at 50 °C, 200 rpm for 24 h, respectively. The samples were extracted with an equal volume of n-butanol, and the top phase (water-saturated n-butanol fraction) was were evaporated and re-dissolved with 100% methanol. The re-dissolved solution was filtered and detected by HPLC. (C) The biotransformation pathways of ginsenosides involved in the reactions.

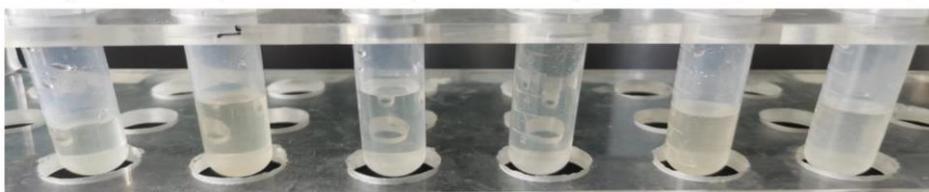
ChCl-P, 1:2   ChCl-U, 1:2   ChCl-EG, 1:2   ChCl-B, 1:2   ChCl-G, 1:1   ChCl-G, 1:2



ChCl-Ca, 1:1   ChCl-Dg, 1:1   ChCl-Ma, 1:1   ChCl-X, 1:2   ChCl-Ma-X, 1:1:1   ChCl-U-G, 1:1:1



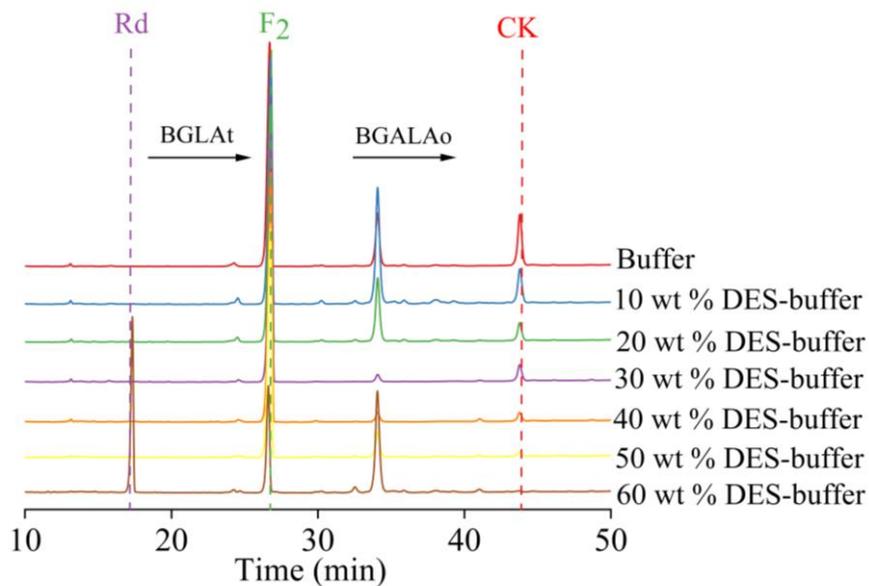
Bet-X, 1:2   Bet-X, 2:1   Bet-EG, 1:2   Bet-G, 1:2   Bet-X, 1:1   Bet-Ca, 1:1



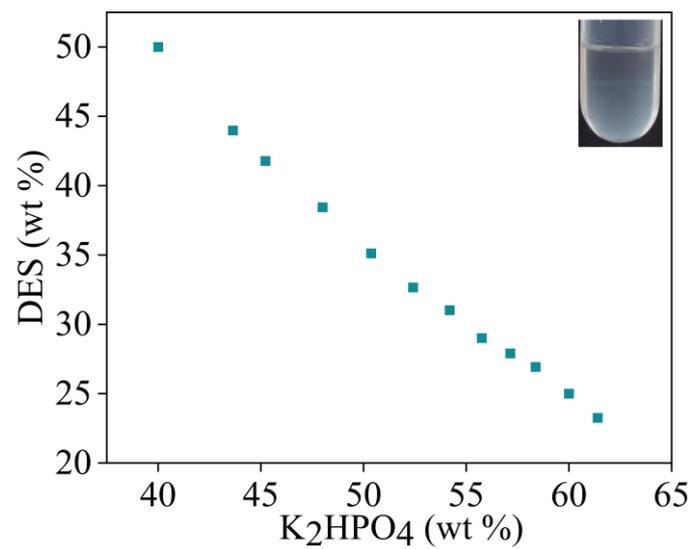
ChCl-Glu, 5:2   Bet-G, 1:1   Bet-Ma-Glu, 1:1:1   Bet-U, 1:2   Bet-Ma, 1:1   Bet-Glu, 5:2



**Figure S2.** 24 combinations of DES. Abbreviations reference Table 1.



**Figure S3.** HPLC analysis of the effect of DES concentration on the conversion of ginsenosides. DES was prepared by betaine and ethylene glycol at a molar ratio of 1:2. 300 U/mL BGLAt and 170 U/mL BGALAO reacted with the final concentration of 5 g/L GE in different concentrations (10, 20, 30, 40, 50, and 60 wt %) of DES-buffer (20 mM, pH 6.0 citrate buffer) at 50 °C, 200 rpm for 24 h, respectively. The samples were extracted with an equal volume of n-butanol, and the top phase (water-saturated n-butanol fraction) was evaporated and re-dissolved with 100% methanol. The re-dissolved solution was filtered and detected by HPLC.



**Figure S4.** Phase diagram of the DES-based ATPS. DES was prepared by betaine and ethylene glycol at a molar ratio of 1:2.