## Hydrophobic amine-based binary mixtures of active pharmaceutical and food grade ingredients: characterization and application in indium extraction from aqueous hydrochloric acid media

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## Supplementary Information

## Table S1. Parameters for qNMR

Compound	Shift (ppm)	Environment	T <sub>1</sub> (s)
Maleic Acid	6.24	Alkene	5.4 ± 0.5
DL-Menthol	0.60	Methyl	0.76 ± 0.03
Methyl Anthranilate	3.83	Methyl Ester	$2.39 \pm 0.14$
Lidocaine	2.05	Methyl	$1.46 \pm 0.03$
Proton Sponge	2.96	Methyl	$1.075 \pm 0.012$



Fig. S1 DSC data for pure compounds (see Table 2 for clarity). The melting temperature is indicated in the figure.



Fig. S2 Composition-dependent DSC data for (a) MA:PS (b) MA:Mnt (c) MA:Ibu (d) Mnt:Lid (e) Mnt:PS (f) Lid:Ibu and (g) Ibu:PS. The composition is reported as wt:wt, with the glass transition temperature highlighted as needed for clarity.



Fig. S3 Plot of glass transition temperature as a function of composition. The X-axis values indicate the mass fraction of the first compound listed in the label (ie lbu in lbu:Lid, Mnt in Mnt:Lid and Mnt in Mnt:lbu). Lines are fit according to Eqs. 5 (solid) and 7 (dashed) in the main text.



Fig. S4 Temperature dependent dynamic viscosity for both the dry and water pre-saturated Lid: Ibu (5:5 weight ratio) system.



Fig. S5 pH-dependent aqueous phase solubility of the hydrogen bond donor for (a) methyl anthranilate- and (b) menthol-based mixtures into hydrochloric acid. The subscript NMR indicates the total measured concentration (protonated and neutral combined). Lines are drawn to guide the eye.

## Temperature dependency of indium extraction into hydrophobic binary mixtures

InCl<sub>3</sub> salt (99.99%, lot. Y18A026) was purchased from Alfa Aesar. The aqueous phase is made of InCl<sub>3</sub> (1 mmol·L<sup>-1</sup>) dissolved gravimetrically in HCl (0.1 mol·L<sup>-1</sup>). The binary mixtures were water pre-saturated through addition of 1 mass equivalent of water, thorough shaking, and left to equilibrate overnight. A standard liquid-liquid extraction technique was applied. Equal volumes (0.5 mL) of each phase were combined in a test tube. The system was shaken mechanically (Biosan TS-100 Thermoshaker, precision ±0.5 °C) at a given temperature at 1400 rpm for 10 min and then centrifuged (VWR Microstar) at 4400 rpm for 1 min. An aliquot (usually 400  $\mu$ L) of each phase was diluted in 1% HCl and then measured with a Varian 720 ES Inductively coupled plasma-optical emission spectrometer (ICP-OES). The wavelength selected is 325.609 nm for indium. All the experiments were repeated three times. Results are shown in



Fig. S6 Effect of initial acid concentration on the extraction of indium into water pre-saturated Mnt:Lid and Mnt:PS. Lines are drawn to guide the eye. Fig. S7.



Fig. S7 Extraction efficiency of indium into water pre-saturated binary mixtures from 0.1 M HCl as a function of temperature. Lines are drawn to guide the eye.



Fig. S8 Indium extraction from 0.05 M HCl into Mnt:Lid binary mixture as a function of DL-menthol content. Lines are drawn to guide the eye.