Supporting Information

- **Wet impregnation method**

The wet impregnation method was employed to incorporate $Fe(NO_3)_3{\cdot}9H_2O$ or $Cu(NO_3)_2{\cdot}3H_2O$ onto delaminated clays or layered double hydroxides (LDH) to achieve a 5 wt% metal loading. The required amount of metal precursor was calculated based on the mass of the support and dissolved in deionized water under continuous stirring to ensure complete dissolution. The delaminated clay or LDH was then added to the solution while maintaining constant agitation at room temperature for 12 hours to allow for metal precursor adsorption. After the impregnation step, excess solvent was removed by slow evaporation at 60°C, followed by drying at 105°C overnight to eliminate residual moisture. The dried samples were then subjected to thermal treatment in a muffle furnace at temperatures ranging from 400 for 4 hours.

- Fe catalyst 5% by weight.

$$0{,}05g\ Fe * \frac{1\ mol\ Fe}{56g\ Fe} * \frac{1mol\ Fe(NO_3)_3.9H_2O}{1mol\ Fe} * \frac{403{,}86\ g\ Fe(NO_3)_3.9H_2O}{1\ mol\ \ Fe(NO_3)_3.9H_2O}$$

$$= 0{,}36g\ Fe(NO_3)_3.9H_2O$$

- Cu catalyst 5% by weight.

$$0{,}05g\ Cu * \frac{1\ mol\ Cu}{63{,}5g\ Cu} * \frac{1mol\ Cu(NO_3)_2.3H_2O}{1mol\ Fe} * \frac{241{,}6\ g\ Cu(NO_3)_2.3H_2O}{1\ mol\ \ Cu(NO_3)_2.3H_2O}$$

$$= 0{,}19g\ Cu(NO_3)_2.3H_2O$$

- **Quantification of 17 α-Ethinylestradiol**

- Calibration Curve for the Quantification of 17 α-Ethinylestradiol

High-performance liquid chromatography coupled with mass spectrometry (HPLC-MS) was used to quantify *17 α-ethinylestradiol* in a concentration range of 1 to 10 ppm. Standard solutions were prepared at concentrations of 1, 3, 5, 7, and 10 ppm. The calibration curve was constructed based on the peak area obtained for each concentration, and a linear regression model was fitted.

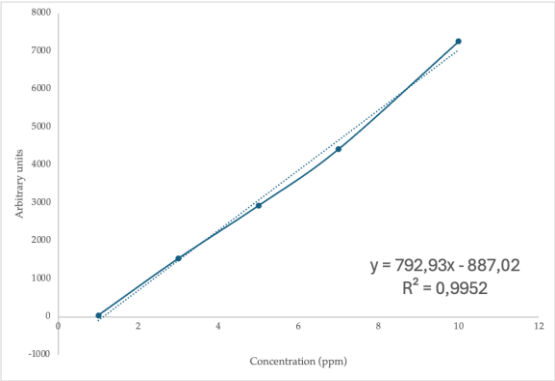


Figure S1. Calibration Curve for 17 α-Ethinylestradiol

- Validation Parameters

Table S1. Validation parameters of the HPLC-MS quantification method for 17 α-Ethinylestradiol.

Parameter	Value
Working range	1 – 10 ppm
Calibration equation	y=792.93x−887.02
R^2	0.9952
Limit of Detection (LOD)	0.33 ppm
Limit of Quantification (LOQ)	1.0 ppm
Precision (RSD%)	< 15% at all levels
Accuracy (Recovery, %)	85 – 115%

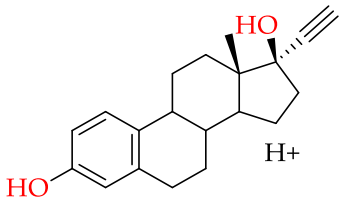
- Validation Protocol

Standard solutions of *17 α-ethinylestradiol* were prepared at concentrations of 1, 3, 5, 7, and 10 ppm by diluting a stock solution in the mobile phase. Five calibration points were established within the working range of 1–10 ppm. For each calibration point, five injections were performed to ensure reproducibility. Precision was evaluated using the coefficient of variation (CV%), which remained consistently below 15% across all concentrations. Accuracy was assessed by comparing the measured concentrations with the theoretical values, yielding recoveries between 85% and 115%.

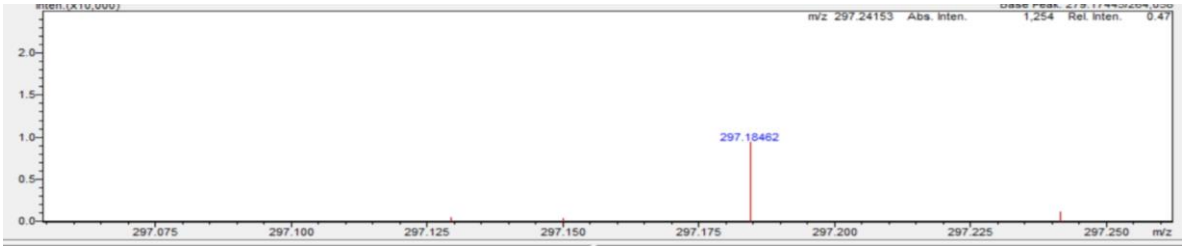
- **Degradation Byproducts**

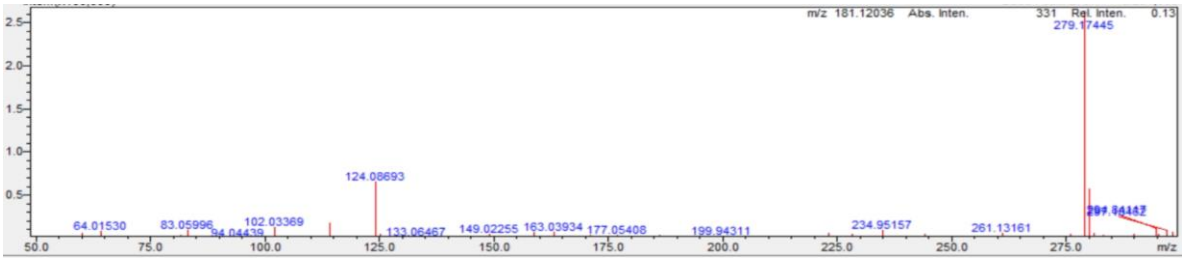
Formula	Calculated mass [M+H]	Mass found [M+H]	Error ppm [M+H]

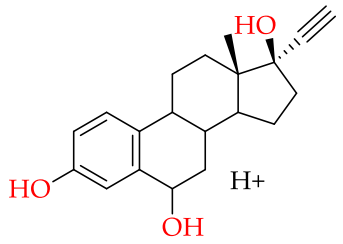
$C_{20}H_{24}O_2$	297,18491	297,18456	-1,17772
$C_{20}H_{24}O_3$	313,17982	313,1785	-4,21483
$C_{20}H_{22}O_2$	295,16926	295,16739	-6,33535
$C_{20}H_{22}O_3$	311,16417	311,16438	0,67488
$C_{20}H_{18}O$	275,14304	275,14424	4,36137
$C_{18}H_{20}O_4$	301,14344	301,14160	-6,11005
$C_{20}H_{22}O_4$	327,15909	327,15859	-1,52831



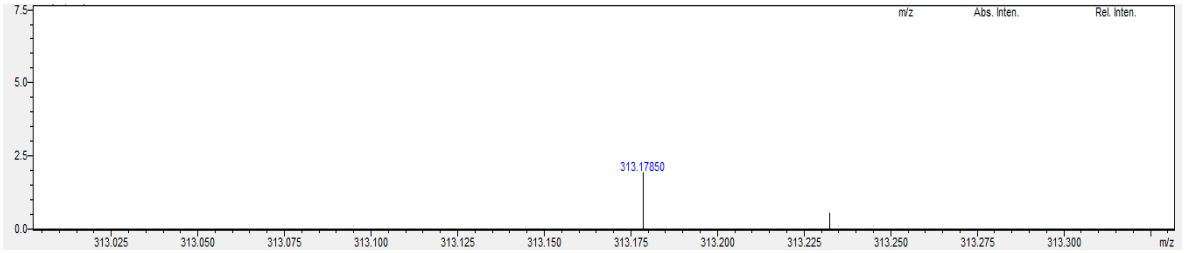
Chemical Formula: $C_{20}H_{25}O_2^+$
Exact Mass: 297,18491

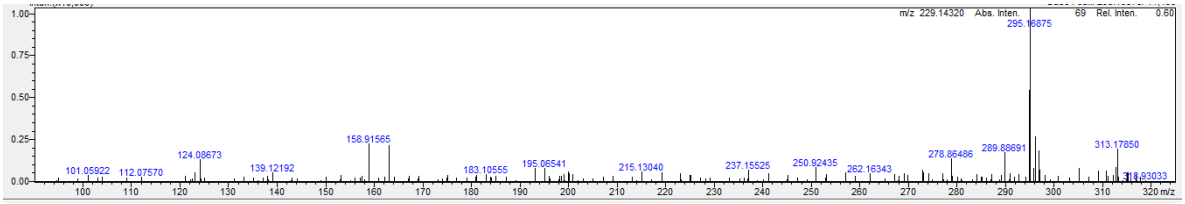


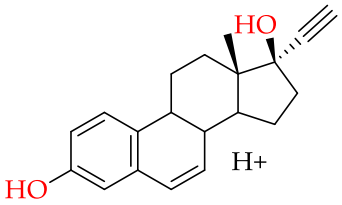




Chemical Formula: $C_{20}H_{25}O_3^+$
Exact Mass: 313,17982

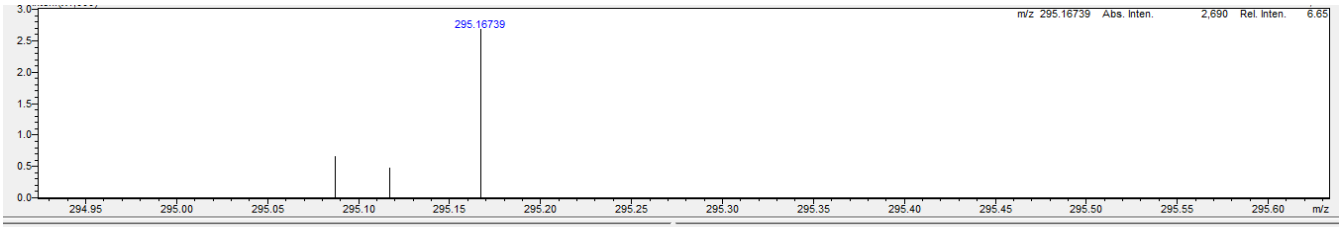


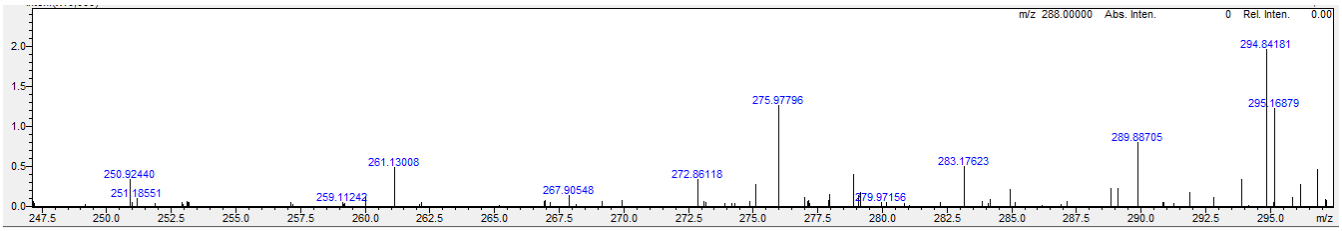


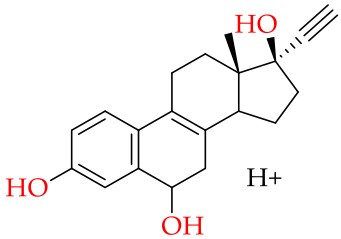


Chemical Formula: $C_{20}H_{23}O_2^+$

Exact Mass: 295,16926

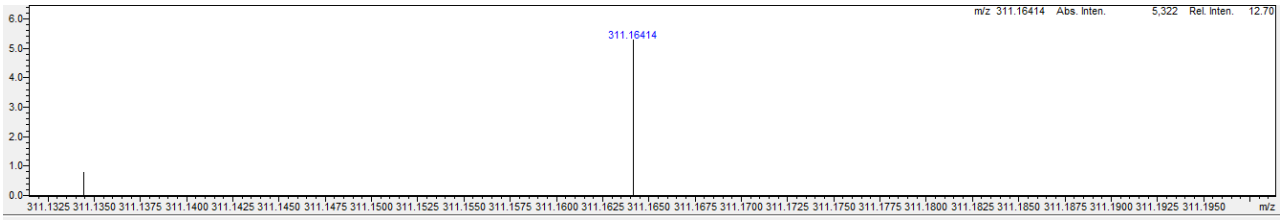


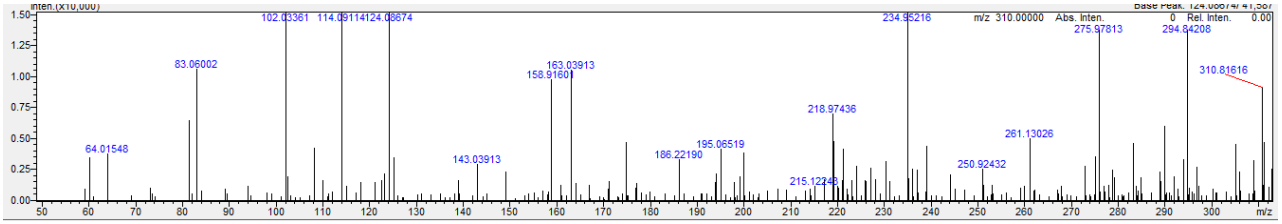


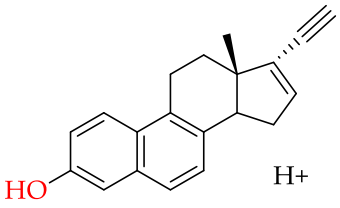


Chemical Formula: $C_{20}H_{23}O_3^+$

Exact Mass: 311,16417

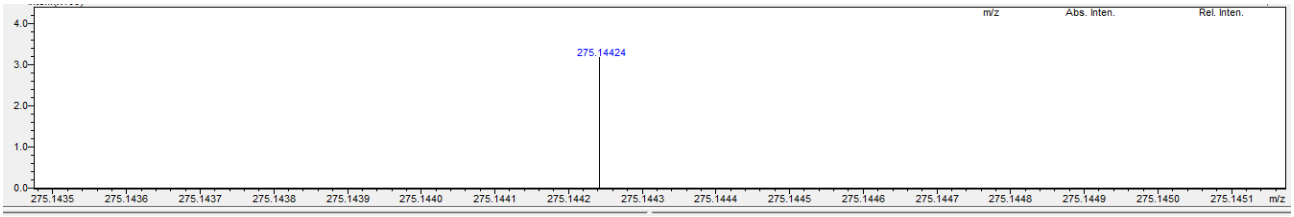


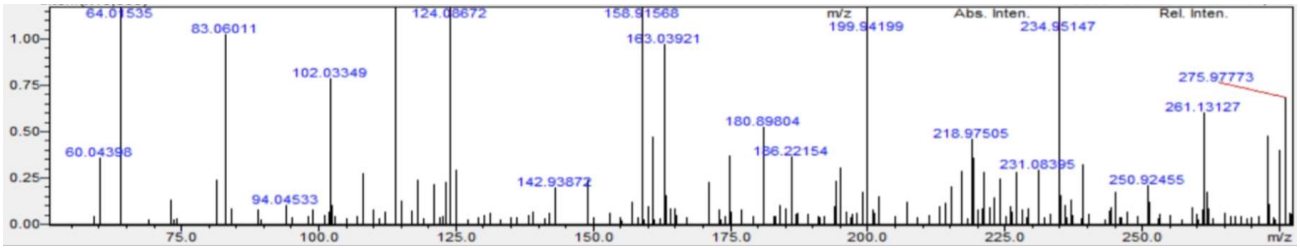


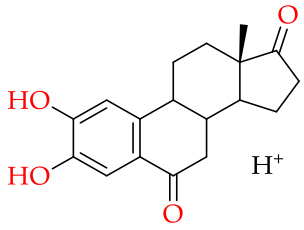


Chemical Formula: $C_{20}H_{19}O^{+}$

Exact Mass: 275,14304

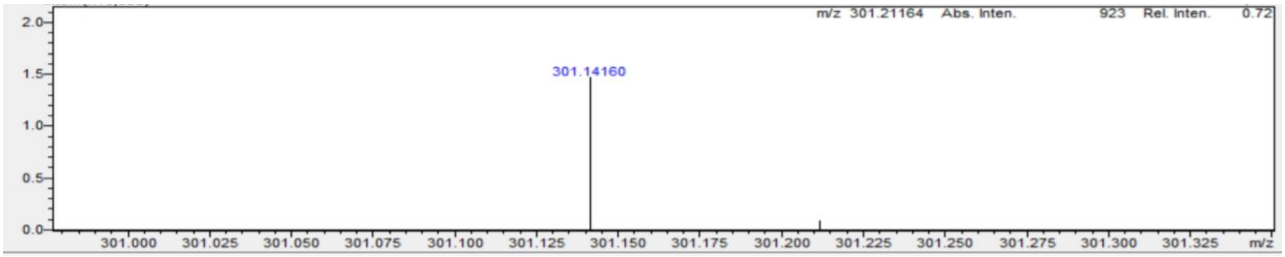


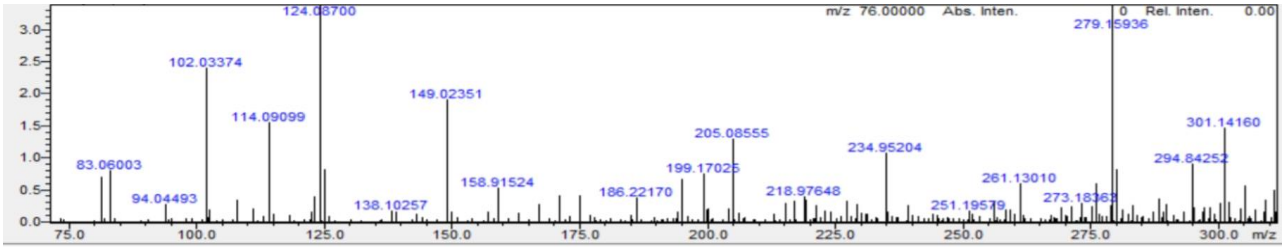


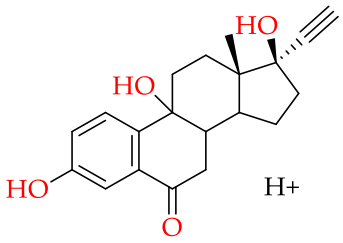


Chemical Formula: $C_{18}H_{21}O_4^{+}$

Exact Mass: 301,14344







Chemical Formula: $C_{20}H_{23}O_4^+$

Exact Mass: 327,15909

