Supplementary Information

Nature's touch in the laboratory: Eco-friendly and green dual-mode UV-Vis and smartphone RGB analysis of procaine in pharmaceuticals using non-heated aqueous matcha green tea extract

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Supplementary Data Contains;

(i) Figures (Fig. S1),
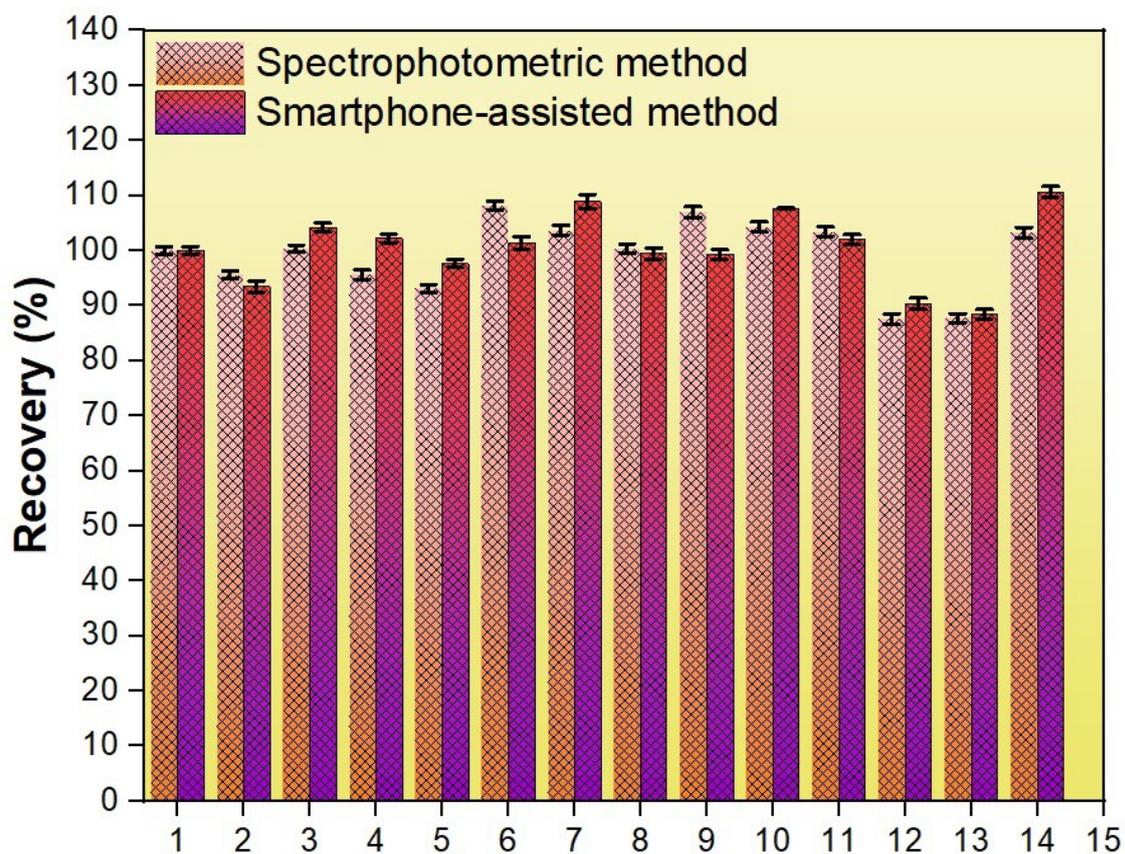(ii) Tables (Table S1, Table S2 and Table S3).

Supplementary Figures

Figure S1 The response of procaine(1) and potential interferents {F^- (2), Cl^- (3), NO_3^- (4), CO_3^{2-} (5), SO_4^{2-} (6), K^+ (7), Na^+ (8), Ca^{2+} (9), Mg^{2+} (10), Mn^{2+} (11), Fe^{2+} (12), [(Fe^{3+} + EDTA] (13), and Al^{3+} (14)} in the presence of procaine at a final concentration of 6.0 mg L^{-1} for both methods.

Supplementary Tables

Table S1 Results for procaine recovery (%) when possible interfering ionic species are present.

Interferent	Mass ratio (procaine: ions (w/w))	Error (%)	
		For spectrophotometer	**For smartphone**
F^-	50	−4.38	−6.55
Cl^-	50	+0.38	+4.21
NO_3^-	50	+4.37	+2.20
CO_3^{2-}	50	−6.88	−2.35
SO_4^{2-}	50	+8.17	+1.40
K^+	50	+3.67	+2.35
Na^+	50	+0.38	+1.4
Ca^{2+}	50	+6.95	+8.92
Mg^{2+}	50	+4.25	−0.55
Mn^{2+}	50	+3.42	+1.98
Fe^{2+}	50	−12.45	−9.66
Fe^{3+}	4	−12.80	−11.21
	5	before EDTA masking: −27.12 after EDTA masking: −12.25	before EDTA masking: −21.36 after EDTA masking: −11.37
Al^{3+}	50	+3.22	+10.65

Table S2. Pharmaceutical samples, formulation types, active components, and excipients used in real sample analysis

Pharmaceutical samples	Formulation types	Active components	Excipients
Local anesthetic (Injection A and injection B solution)	Injection solution	Procaine Hydrochloride (10 000 mg L^{-1})	Hydrochloric acid (for pH adjustment), water for injection
Simulated glycerin-based local anesthetic sample	Topical solution	Procaine Hydrochloride (21 010 mg L^{-1})	Glycerin

Table S3. Comparing the reference spectrophotometric method with the recommended spectrophotometric and smartphone-assisted methods for procaine analysis statistically at a 95% confidence level.

Method	Mean Conc. (mg L^{-1})	SD (σ)	S[a,b]	t[a,b]	t$_{table}$[b]	F[b]	F$_{table}$[b]
Recommended method (for spectroscopy)	9 990	162	-	-	-	-	-
Spectrophotometric reference method (for spectroscopy)	10 230	198	221	2.038	2.306	1.496	6.39
Recommended method (for smartphone)	9 980	98.1	-	-	-	-	-
Spectrophotometric reference method (for smartphone)	10 230	198	221	1.718	2.306	4.063	6.39

[a]$S^2=((n_1-1)s_1^2 + (n_2-1)s_2^2)/(n_1+n_2-2)$ and $t=(\bar{a}_1-\bar{a}_2)/(S(1/n_1+1/n_2)^{1/2})$, where S is the pooled standard deviation, s_1 and s_2 are the standard deviations of the two populations with sample sizes of n_1 and n_2, and sample means of $\bar{a}_1$ and $\bar{a}_2$ respectively (t has (n_1+n_2-2) degrees of freedom); here, $n_1=n_2=5$. [b]Statistical comparison made on paired data produced with the proposed and reference methods; the results given only on the row of the reference method.