Table S1. Detailed information of green tea samples in the study. Temperature, precipitation, sunshine and humidity were estimated from October of last year to February of this year.

Location	Sample Number	Harvest year	Harvest season	Temperature (°C)	Precipitation (mm)	Sunshine (W/m²)	Humidity (%)
Anji (AJ)	29	2021	Spring	25.53	47.46	70.10	81.98
		2022	Spring	18.17	59.62	72.68	83.32
Songyang (SY)	20	2021	Spring	25.14	32.70	78.45	82.75
		2022	Spring	18.12	77.28	80.49	84.65
Hubei (HB)	25	2021	Spring	19.97	63.28	69.56	83.38
		2022	Spring	16.58	43.95	74.59	82.56
Guizhou (GZ)	20	2021	Spring	20.37	40.08	72.46	86.23
		2022	Spring	16.58	43.95	85.88	76.35

Table S2. Correlation analysis between soil factors and biochemical composition of tea samples. ACa is referred to available Ca, AK is referred to available K, AMg is referred to available Mg, and AP is referred to available P. * and ** respectively represent significant difference at the p = 0.05 and p = 0.01 confidence level.

	pH	ACa	AK	AMg	AP
GA	0.261*	0.201	-0.08	0.084	-.251*
GC	0.035	-0.105	-0.123	0.009	0.082
C	-0.057	-0.18	-0.169	-0.097	-0.168
ECG	-0.376**	-.318**	-0.043	-0.188	0.292**
EGCG	0.146	-0.072	-0.035	-0.069	-.321**
EGC	0.11	-0.086	-0.196	0.004	-0.13
CAF	0.201	0.031	0.001	-0.011	-.352**
GCG	-0.001	-0.101	-.312**	-0.101	-.206*
EC	-0.104	-0.121	-0.03	-0.012	0.041
His	0.029	0.034	-0.024	-0.041	-0.148
Ser	0.077	0.001	-0.03	-0.068	-.307**
Gln	0.061	-0.006	0	-0.064	-.225*
Arg	0.018	0.063	-0.127	0.009	-0.193
Gly	-0.22	-0.158	-0.115	-0.156	-0.08
Asp	0.201	0.154	-0.073	0.048	-.295**
Glu	0.046	0.035	-0.043	-0.004	-.358**
Thr	0.2	0.027	-0.035	-0.063	-.307**
Ala	0.159	0.098	-0.06	0.014	-.416**
GABA	-0.362**	-.219*	0.006	-0.184	0.168
Eth	-0.093	-0.073	-0.117	-0.038	-.297**

Thea	0.061	0.016	-0.018	-0.051	-.332**
Pro	-0.039	-0.126	-0.016	-0.167	-0.135
Cys	-0.343**	-.217*	-0.087	-0.187	0.178
Lys	-0.116	-0.161	-0.101	-0.159	-0.015
Tyr	-0.112	-0.155	-0.011	-0.176	-0.033
Met	-0.023	-0.022	-0.075	-0.009	0.101
Val	0.017	-0.053	-0.067	-0.107	-0.154
Ile	0.078	-0.043	-0.057	-0.118	-0.185
Leu	0.058	-0.06	-0.065	-0.124	-0.142
Phe	0.051	-0.06	-0.059	-0.112	-0.063

Table S3. Correlation analysis between soil factors and mineral elements of tea. * and ** respectively represent significant difference at the p = 0.05 and p = 0.01 confidence level.

	pH	ACa	AK	AMg	AP
Al	-0.116	0.096	-0.024	0.136	0.12
B	.325**	.236*	0.123	0.154	-.301**
Ba	.346**	.415**	-.215*	.406**	-0.005
Ca	.455**	.447**	-0.002	.358**	-0.124
Cd	-.268**	-0.043	0	-0.098	0.184
Co	-0.195	-0.064	0.12	-0.049	0.039
Cr	.335**	.464**	-0.081	.326**	0.019
Cu	0.115	0.198	-0.144	0.189	0.014
Fe	.581**	.550**	-0.043	.394**	-.354**
K	-0.075	0.013	-0.051	0.011	0.097
Mg	.315**	.286**	0.021	.255*	-0.146
Mn	-0.145	-0.019	0.062	-0.062	0.008
Na	-0.074	0.038	0.111	-0.026	0.057
Ni	0.18	.297**	-0.147	.249*	-.209*
P	-0.067	0.01	0.134	-0.056	0.141
S	0.092	.222*	-0.099	0.084	-0.104
Ti	.343**	.603**	0.019	.489**	0.031
V	-.423**	-0.203	-0.002	-0.132	.331**
Zn	0.13	0.095	-0.048	0.043	-0.004
Sn	-0.018	0.119	.277**	.234*	.307**
Sb	-.329**	-0.127	0.06	-0.062	.222*
Bi	.246*	0.184	0.058	0.055	-0.086

Table S4. Correlations analysis between stable isotopes with meteorological factors. RHM is referred to relative humidity, TMR is referred to mean temperature, PRS is referred to precipitation, and CSP is referred to sunshine. * and ** respectively represent significant difference at the p = 0.05 and p = 0.01 confidence level.

	RHM	TMR	PRS	CSP
$\delta^{15}N$	-0.165	-0.149	-0.151	-0.012

$\delta^{13}C$	-0.12	.580**	-.490**	-.426**
$\delta^{18}O$	-0.109	-.541**	.435**	.443**

Table S5. Predictive abilities of the partial least squares discriminant analysis and orthogonal projections to latent structures-discriminant analysis models in discriminating different counties of WLT.

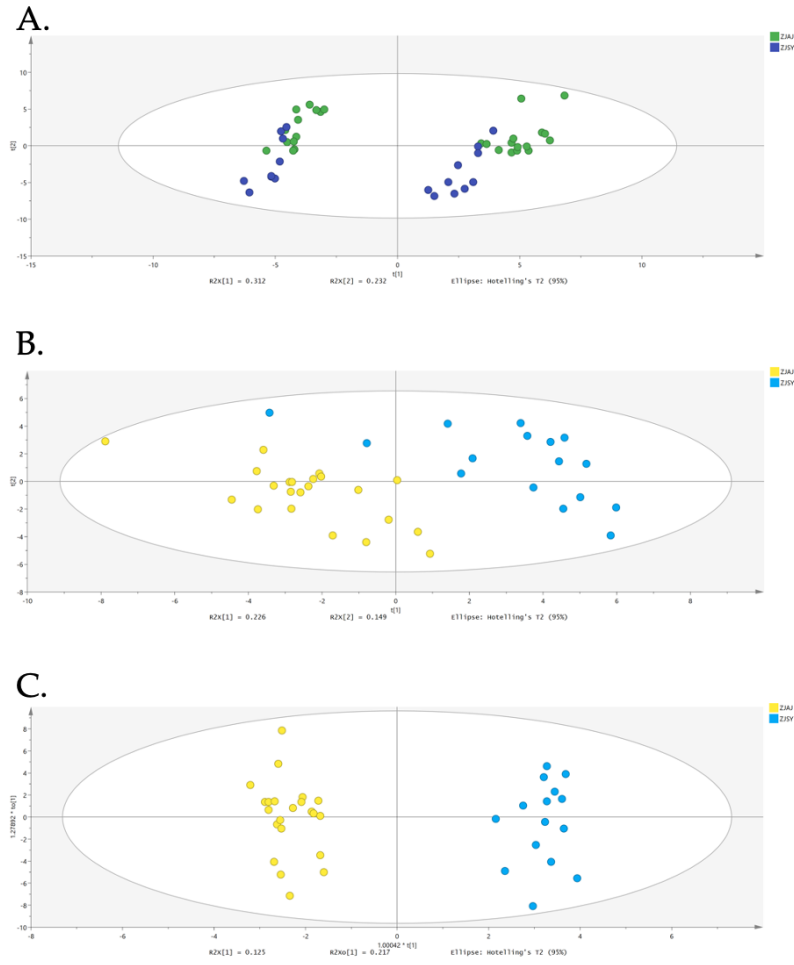|			ZJAJ	ZJSY	accuracy
PLS-DA	Training set	ZJAJ	22	0	100%
		ZJSY	1	15	93.75%
		Total accuracy			97.37%
	Testing set	ZJAJ	6		100%
		ZJSY	1	3	75%
		Total accuracy			90%
OPLS-DA	Training set	ZJAJ	22	0	100%
		ZJSY	0	16	100%
		Total accuracy			100%
	Testing set	ZJAJ	5	1	83.33%
		ZJSY	1	3	75%
		Total accuracy			80%

Figure S1. Analysis on differential white leaf tea origin classification. (A) Principal component analysis score plot for two counties; (B) partial least squares discriminant analysis score plot for two counties; (C) orthogonal projections to latent structures-discriminant analysis score plot for two counties.
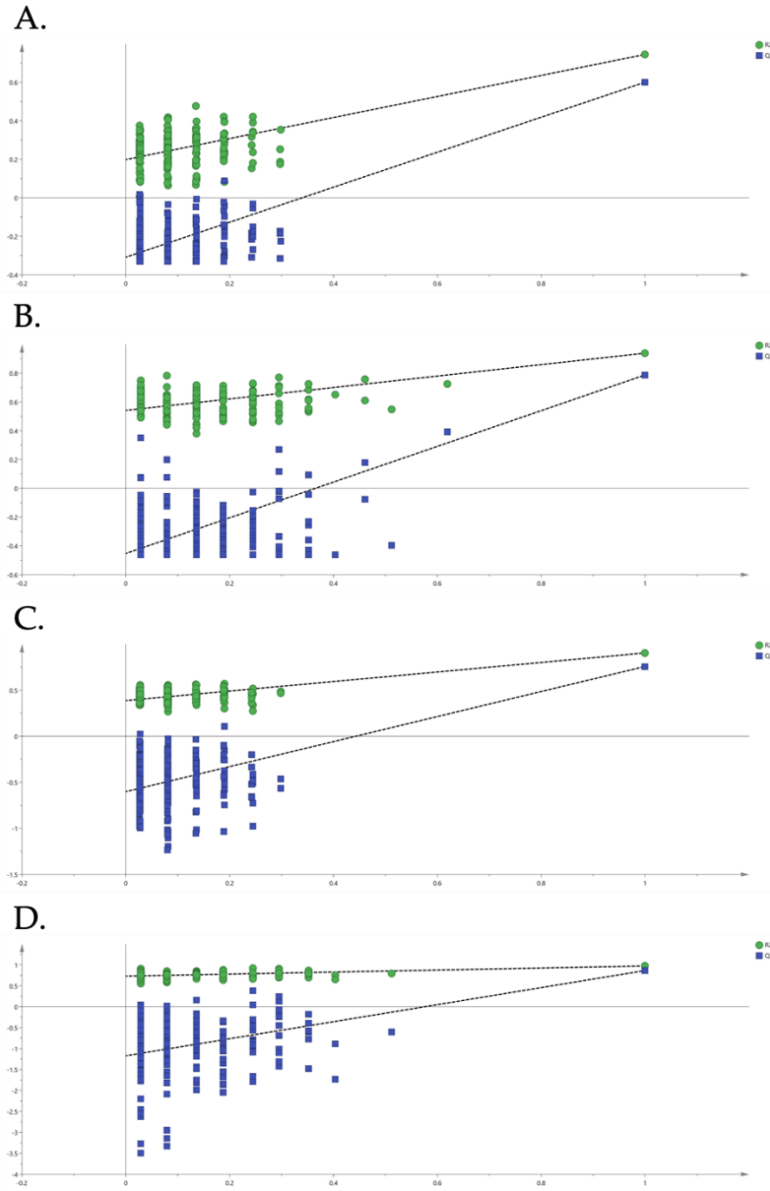
Figure S2. Permutation tests of the partial least squares discriminant analysis models for three provinces (A), and two counties in Zhejiang province(B), the orthogonal projections to latent structures-discriminant analysis models for three provinces (C), and two counties in Zhejiang province (D). The blue regression line of the Q2-points intersects the vertical axis (on the left) below zero, indicates that the original model is valid.
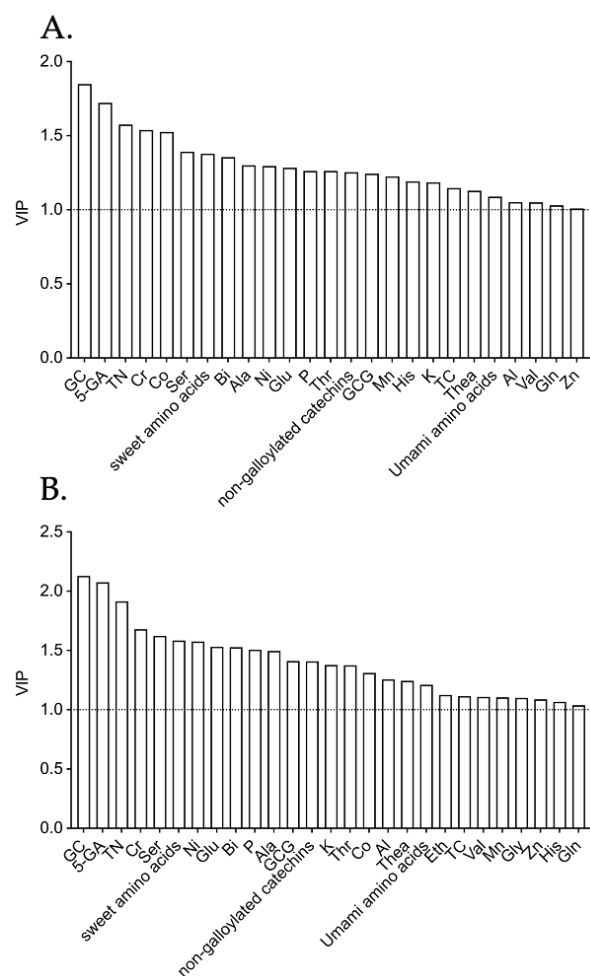
Figure S3. Variable importance plots for (A) partial least squares discriminant analysis model; (B) orthogonal projections to latent structures-discriminant analysis model in discriminating different counties of WLT.