Facile Green Synthesis of Wasted Hops-Based Zinc Oxide Nanozymes as Peroxidase-Like Catalysts for Colorimetric Analysis

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1. Additional Figures

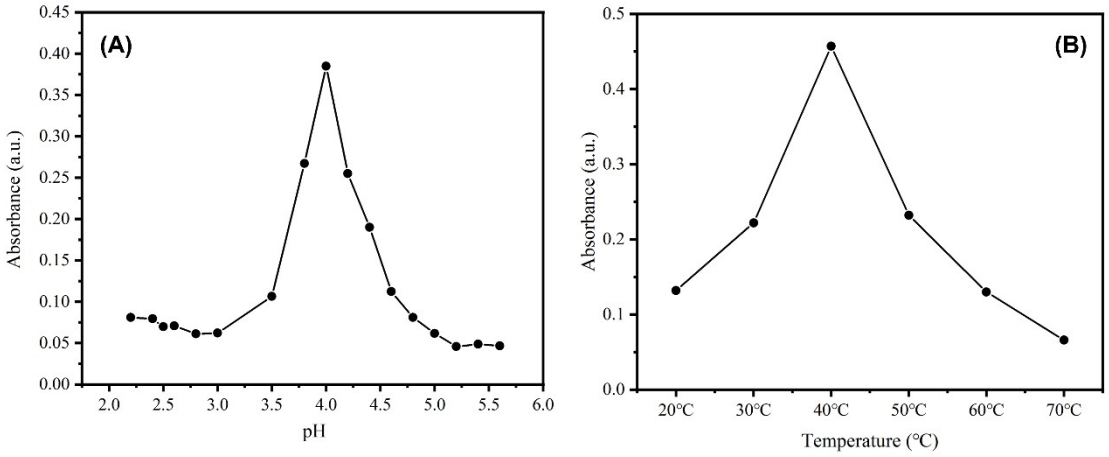

Figure S1. (A) pH-dependent, (B) temperature-dependent POD-like activity of WHE-ZnO NEs.

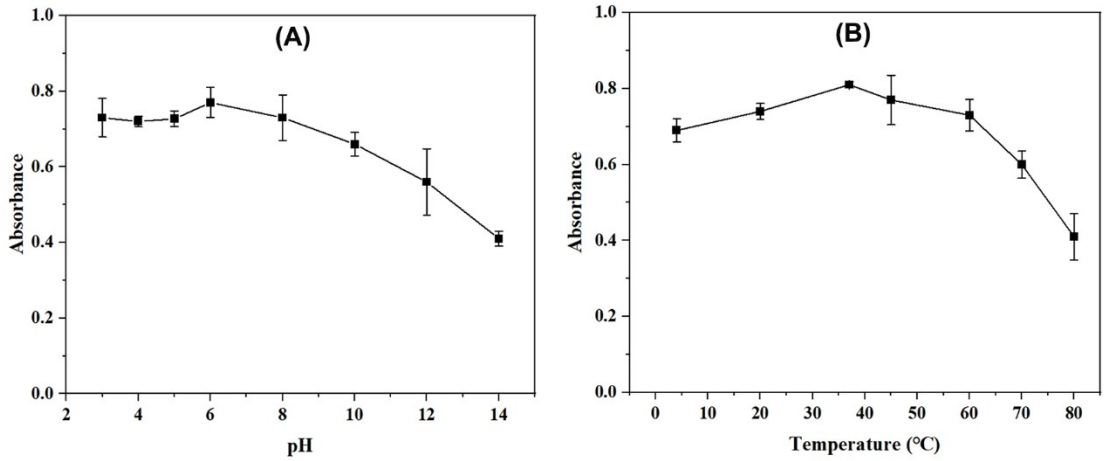

Figure S2. Stability of WHE-ZnO NEs after incubating at various temperature (A) and pH values (B) for 24 h.

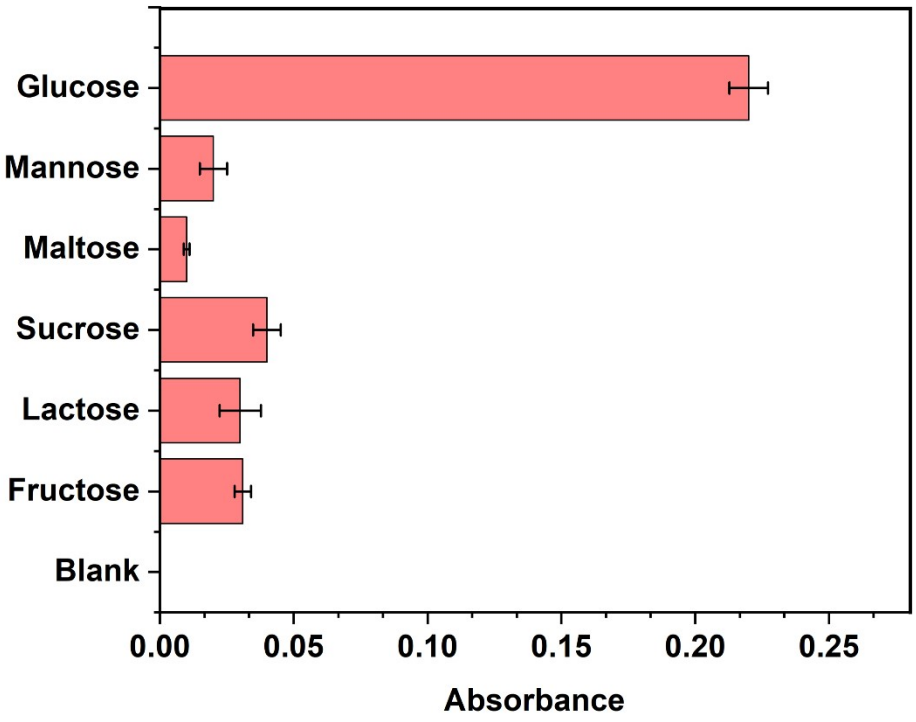

Figure S3. Selectivity evaluation of the glucose detection method.

2. Additional Tables

Table S1. Analysis of active ingredients in hops extract

No.	RT（min）	Compound	Molecular formula	Relative content（%）
1	5.42	Ribitol, 1,3:2,4-di-O-benzylidene	$C_{19}H_{20}O_5$	0.13
2	6.10	1,5-Heptadiene, 3,3,6-trimethyl	$C_{10}H_{18}$	4.04
3	20.03	Phthalic acid, but-3-yn-2-yl cyclohexylmethyl ester	$C_{19}H_{22}O_4$	0.42
4	20.89	Ethanone, 1-(7-hydroxy-5-methoxy-2,2-dimethyl-2H-1-benzopyran-8-yl)	$C_{14}H_{16}O_4$	1.79
5	22.69	O-Vanadic acid, tris(4-pentenyl) ester	$C_{15}H_{27}O_4V$	0.19
6	22.78	Androstan-17-ol	$C_{19}H_{32}O$	0.13
7	23.12	Pregnane-3,11,20-trione, (5.beta.)	$C_{21}H_{30}O_3$	0.34
8	23.22	2,6,9-Undecatrione	$C_{11}H_{18}O_3$	0.39
9	23.31	2-Pyrimidinamine, 5-bromo-4-methoxy-6-methyl	$C_6H_8BrN_3O$	0.54
10	23.43	Epiandrosterone	$C_{19}H_{30}O_2$	0.27
11	23.54	Benzene, hexa(1-propenyl)	$C_{24}H_{30}$	1.42
12	23.68	Acridin-9-yl-(5-methyl-[1,3,4]thiadiazol-2-yl)-amine	$C_{16}H_{12}N_4S$	0.32
13	23.74	Propanenitrile, 3-[1-[3-(1-pyrrolidinyl)propynyl]-1-cyclohexyloxy]	$C_{16}H_{24}N_2O$	0.3
14	23.86	Lupulon	$C_{26}H_{38}O_4$	47.98
15	24.03	(7-tert-Butyl-2-cyclopropyl-5,6,7,8-tetrahydrobenzo[4,5]thieno[2,3-d]pyrimidin-4-ylsulfanyl)acetic acid	$C_{19}H_{24}N_2O_2S_2$	1.2
16	48.55	Phenol, 2,4-bis(1-phenylethyl)	$C_{22}H_{22}O$	9.5
17	24.41	Imidazo[1,5-a]pyrrolo[2,1-c][1,4]benzodiazepine-1-carboxylic acid, 7-chloro-9-oxo-11,12,13,13a-tetrahydro, ethyl ester	$C_{17}H_{16}ClN_3O_3$	1.37
18	24.46	Benz[a]anthracene-7,12-diol, 7,12-dihydro-7,12-dimethyl-, cis	$C_{20}H_{18}O_2$	0.63
19	24.49	Dronabinol	$C_{21}H_{30}O_2$	0.66
20	24.87	26,27-Dinorergosta-5,22-dien-3-ol, (3.beta.,22E)	$C_{26}H_{42}O$	1.95
21	25.00	Phenol, 2,4-bis(1-methyl-1-phenylethyl)	$C_{24}H_{26}O$	2.93
22	25.05	3-(1-Acetoxyethyl)-3-phenylpiperidin-2,6-dione	$C_{15}H_{17}NO_4$	1.92
23	25.16	Cholest-20(22)-ene-3,6-dione, (5.alpha.)	$C_{27}H_{42}O_2$	1.81
24	25.20	Tetralin-1-methylamine, N-cyclohexyl-N-oxide	$C_{17}H_{23}NO$	0.7
25	25.39	1H-Pyrano[3',4':6,7]indolizino[1,2-b]quinoline-3,14(4H,12H)-dione, 4-ethyl-4-hydroxy-, (S)	$C_{20}H_{16}N_2O_4$	1.82
26	25.45	Ergosta-7,22-dien-3-ol, (3.beta.,5.alpha.,22Z)	$C_{28}H_{46}O$	1.33
27	25.50	Isoindole-1,3(2H)-dione, 5,6-dichloro-2-phenyl	$C_{14}H_7Cl_2NO_2$	1.11
28	25.60	Androstane-17-carboxylic acid, 3-(acetyloxy)-14-hydroxy-, methyl ester, (3.beta.,5.beta.,14.beta.,17.beta.)	$C_{23}H_{36}O_5$	1.11
29	25.70	D:A-Friedooleanane	$C_{30}H_{52}$	1.91
30	25.86	Retinoic acid, 5,6-epoxy-5,6-dihydro-, methyl ester	$C_{21}H_{30}O_3$	0.55
31	25.92	5.alpha.-Androstane, 3.alpha., 11.alpha., 17.beta.-trihydroxy	$C_{19}H_{32}O_3$	0.89
32	26.01	Cholesta-8,14-dien-3-ol, 4,4-dimethyl-, (3.beta.,5.alpha.)	$C_{29}H_{48}O$	2.17
33	26.10	Oxalic acid, momoamide, N-(2-chlorophenyl)-, butyl ester	$C_{12}H_{14}ClNO_3$	0.49
34	26.14	N-(2-Amino-4-chlorophenyl)anthranilic acid	$C_{13}H_{11}ClN_2O_2$	0.37
35	26.21	4H-Pyrido[4,3-b]indole-4,4-dicarboxylic acid, 1,2,3,5-tetrahydro-2-methyl-, diethyl ester	$C_{18}H_{22}N_2O_4$	1.38
36	26.39	Disilane, 1,1,1,2,2-pentamethyl-2-[(cyclopropyl)(phenylthio)methyl]	$C_{15}H_{26}SSi_2$	0.58

37	26.53	4-(4-Methoxy-6-methyl-5,6,7,8-tetrahydro-[1,3]dioxolo[4,5-g]isoquinolin-5-yl)-5-propyl-2,4-dihydro-pyrazol-3-one	$C_{18}H_{23}N_3O_4$	0.46
38	26.68	13-Docosenamide, (Z)	$C_{22}H_{43}NO$	2.35
39	26.86	1-(1,1,2,3,3,3-Hexafluoropropyl)-4,5-bis(methoxycarbonyl)-1,2,3-triazole	$C_9H_7F_6N_3O_4$	0.7
40	26.91	3-Morpholino-thioacrylomorpholide	$C_{11}H_{18}N_2O_2S$	0.17
41	27.02	2-(4,7-Dimethyl-quinazolin-2-ylamino)-6-methyl-pyrimidin-4-ol	$C_{15}H_{15}N_5O$	0.21
42	27.23	Estra-1,3,5(10)-trien-17-one, 3,7-dihydroxy-, O-methyloxime, (7.alpha.)	$C_{19}H_{25}NO_3$	0.15
43	27.35	Androstane, (5.beta.,14.beta.)	$C_{19}H_{32}$	0.27
44	28.19	Benzeneacetic acid, 3-methoxy-4-[(trimethylsilyl)oxy]-, ethyl ester	$C_{14}H_{22}O_4Si$	0.25
45	28.85	Cyclodeca[b]furan-2(3H)-one, 9-(acetyloxy)-3a,4,5,8,9,11a-hexahydro-4-hydroxy-6,10-dimethyl-3-methylene	$C_{17}H_{22}O_5$	0.17
46	29.37	5,5',8,8'-Tetrahydroxy-3,3'-dimethyl-2,2'-binaphthalene-1,1',4,4'-tetrone	$C_{22}H_{14}O_8$	0.29
47	29.60	Benzenamine, 4,4',4''-phosphinylidynetris[N,N-dimethyl	$C_{24}H_{30}N_3OP$	0.19
48	29.69	Quinoline, 2-chloro-6-methoxy-4-methyl	$C_{11}H_{10}ClNO$	0.15

Table S2. Analytical results of serum samples by the proposed method.

Sample	Without spiking (mM)	Glucose spiked (mM)	Glucose measured (mM)	Recovery (%)
Serum -1	3.28 ± 0.27	10	12.82 ± 0.79	95.40
Serum -2	3.06 ± 0.55	20	23.91 ± 1.12	104.25
Serum -3	3.58 ± 0.81	50	54.89 ± 1.63	102.62
Serum -4	3.28 ± 0.44	100	107.33 ± 1.54	104.13