

# Highly Sensitive Detection of Carbaryl Pesticides using Potentiometric Biosensor with Nanocomposite Ag/r-Graphene Oxide/Chitosan Immobilized Acetylcholinesterase Enzyme

Mashuni Mashuni <sup>1,\*</sup>, Halimahtussaddiyah Ritonga<sup>1</sup>, Muhammad Jahiding<sup>2</sup>, Bonni Rubak <sup>1</sup> and Fitri Handayani Hamid <sup>1</sup>

<sup>1</sup> Department of Chemistry, Halu Oleo University, Kendari, 93132, Indonesia; halimahhalimah124@yahoo.co.id (H.R.); mybonnieq@gmail.com (B.R); fitrihandayanihamid@gmail.com (F.H.H.)

<sup>2</sup> Department of Physics, Halu Oleo University, Kendari, 93132, Indonesia; mjahiding2019@gmail.com

\* Correspondence: mashuni2696@gmail.com

Table S1. Measurement of potential value

Concentration of Pesticide ( $\mu\text{g mL}^{-1}$ )	-Log [Pesticide] ( $\mu\text{g mL}^{-1}$ )	Potential value (mV vs. Ag/AgCl)					
		i	ii	iii	iv	v	mean
1	0	114.2	117	116.5	113.8	103.4	112.98
$1 \times 10^{-1}$	1	125.9	128.2	124.3	124.6	120.8	124.76
$1 \times 10^{-2}$	2	137.7	135.7	135.2	135.5	128.4	134.5
$1 \times 10^{-3}$	3	145	143.8	140.3	139.6	137.3	141.2
$1 \times 10^{-4}$	4	150.2	149.1	146.9	146.5	144.6	147.46
$1 \times 10^{-5}$	5	159.3	158	154.2	154.9	154.4	156.16
$1 \times 10^{-6}$	6	165.5	165.2	163.1	163.5	162.3	163.92
$1 \times 10^{-7}$	7	175.8	177.1	174.5	176	175.9	175.86
$1 \times 10^{-8}$	8	185.1	186.2	184.7	184.2	183.2	184.68
blanko		186.4	188	185.7	187.1	186.4	186.72
substrate		198.1	197.9	195.7	197.8	195.8	197.06
y		8.4063x + 115.74	8.2783x + 118.03	8.2183x + 115.98	8.4517x + 114.93	8.6967x + 112.35	8.4063x + 115.74
R <sup>2</sup>		0.995	0.9941	0.9915	0.9912	0.9948	0.995

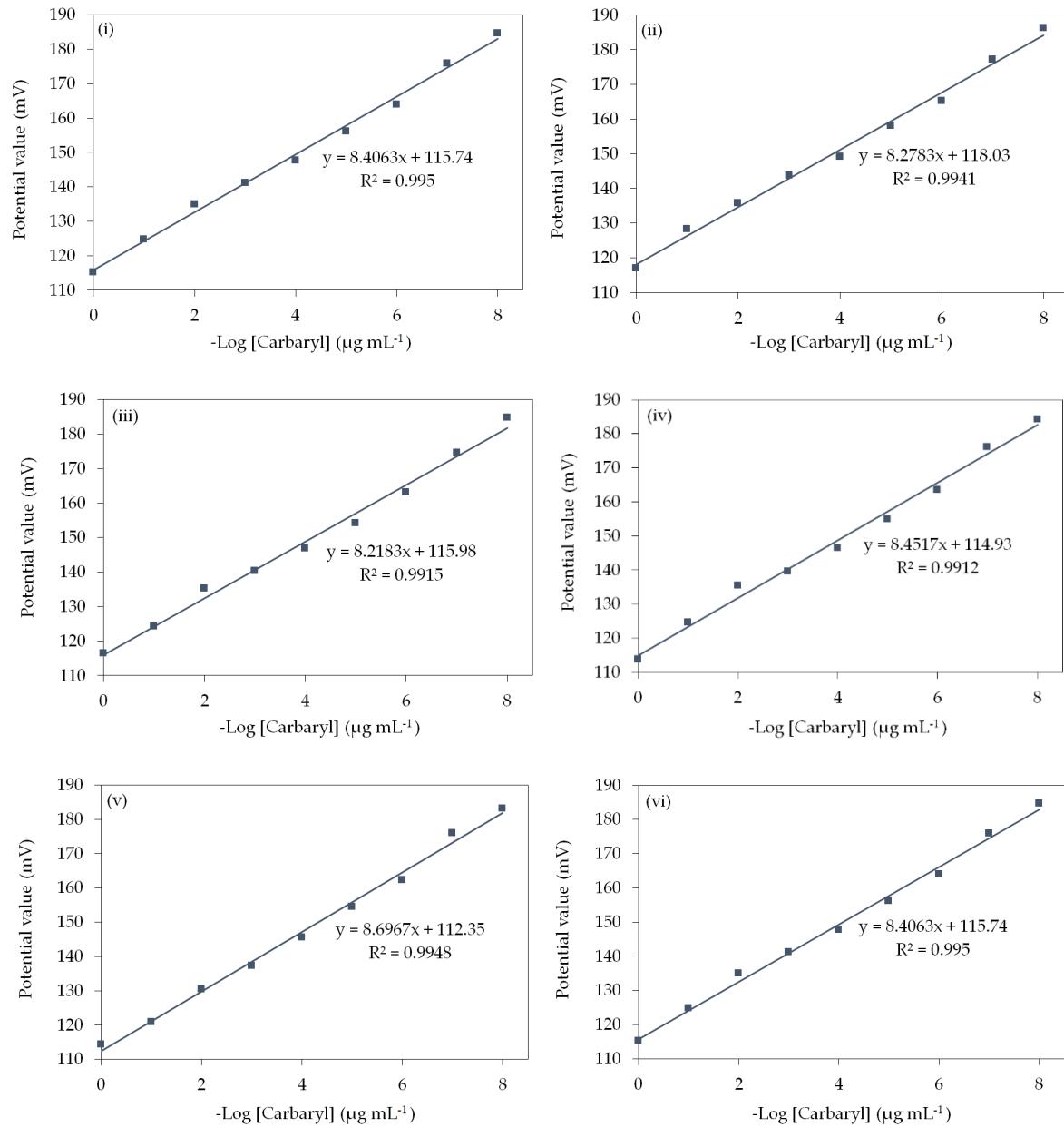


Figure S1. Calibration curve of the relationship of  $-\log [\text{Carbaryl}]$  with the potential value  
 (i) first, (ii) second, (iii) third, (iv) fourth, (v) fifth and (vi) mean of measurement

Table S2. Calculations for determination of Limit of Detection (LOD)

x	y <sub>i</sub>	a	b	y <sub>seb</sub>	y <sub>i</sub> -y <sub>seb</sub>	(y <sub>i</sub> -y <sub>seb</sub> ) <sup>2</sup>
0	115.16	8.38	117.42	117.42	-2.26	5.1076
1	124.76	8.38	117.42	125.8	-1.04	1.0816
2	134.9	8.38	117.42	134.18	0.72	0.5184
3	141.2	8.38	117.42	142.56	-1.36	1.8496
4	147.66	8.38	117.42	150.94	-3.28	10.7584
5	156.16	8.38	117.42	159.32	-3.16	9.9856
6	163.92	8.38	117.42	167.7	-3.78	14.2884
7	175.86	8.38	117.42	176.08	-0.22	0.0484
8	184.68	8.38	117.42	184.46	0.22	0.0484
$\sum (y_i - y_{seb})^2$						43.6864
$\bar{x}$						4.854044
S(y/x)						2.498182
LOD						194.2145 mV
					x(LOD)	$1 \times 10^{-9} \mu\text{g mL}^{-1}$

\*x = - Log [pesticide], y<sub>i</sub> = Potential value (mV), a = slope, b = intercept, y<sub>seb</sub> = calculated

$$\text{potential value, } S(y/x) = \sqrt{\frac{\sum (y_i - y_{seb})^2}{n-2}}, \text{ LOD} = \bar{x} + 3 S(y/x)$$

Table S3. Calculations for determination of inhibition percentage from potential value of substrate (ATCl, 198.1 mV)

[Pesticide] ( $\mu\text{g mL}^{-1}$ )	Potential value (mV vs. Ag/AgCl)	Log [Pesticide]	Inhibition (%)
1	115.16	0	72.0215
$1 \times 10^{-1}$	124.76	-1	58.7848
$1 \times 10^{-2}$	134.9	-2	46.8495
$1 \times 10^{-3}$	141.2	-3	40.2974
$1 \times 10^{-4}$	147.66	-4	34.1595
$1 \times 10^{-5}$	156.16	-5	26.8571
$1 \times 10^{-6}$	163.92	-6	20.8516
$1 \times 10^{-7}$	175.86	-7	12.6464
$1 \times 10^{-8}$	184.68	-8	7.2666

Table S4. Calculations for determination of measurements precision

Curve	a	b
1	8.38	117.42
2	8.27	118.03
3	8.21	115.98
4	8.45	114.93
5	8.69	112.35
mean	8.40	115.74
SD	0.19	2.25
	$8.56 \pm 0.53$	$115.74 \pm 2.25$
RSD (%)	2.23	1.95