Supplementary File

The successful electrode modification process was strengthened by characterization using SEM-EDX presented in Fig S1. There is a very clear difference between these two, Ceria successfully deposited even though agglomeration still occurs. The next characterization was EDS to confirm the presence of Ceria on the electrode and has been compared with other research in Fig S1 (Aponte et al., 2020).

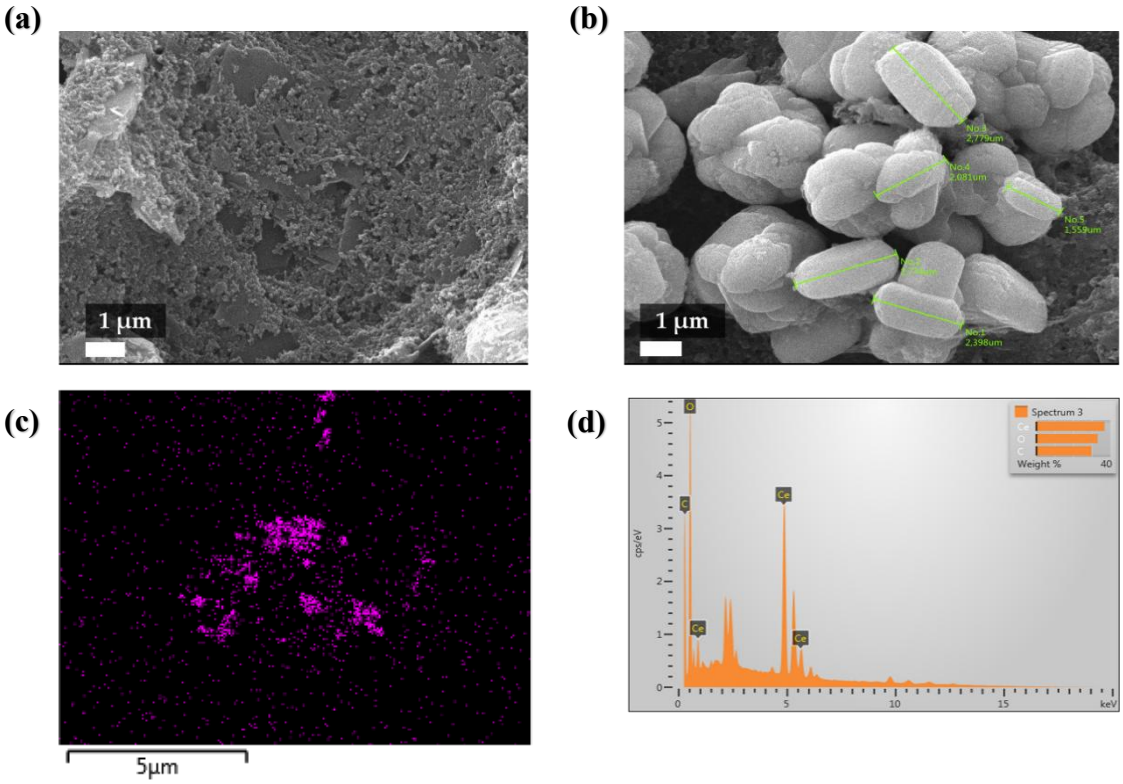

Fig S1. SEM of (a) SPCE bare 10000X;(b) SEM SPCE/ceria 10000X. EDX of (c) ceria mapping in SPCE/ceria; (d) spectrum analysis of SPCE/ceria.

Design of experiment resulting various current peaks (Fig S2)

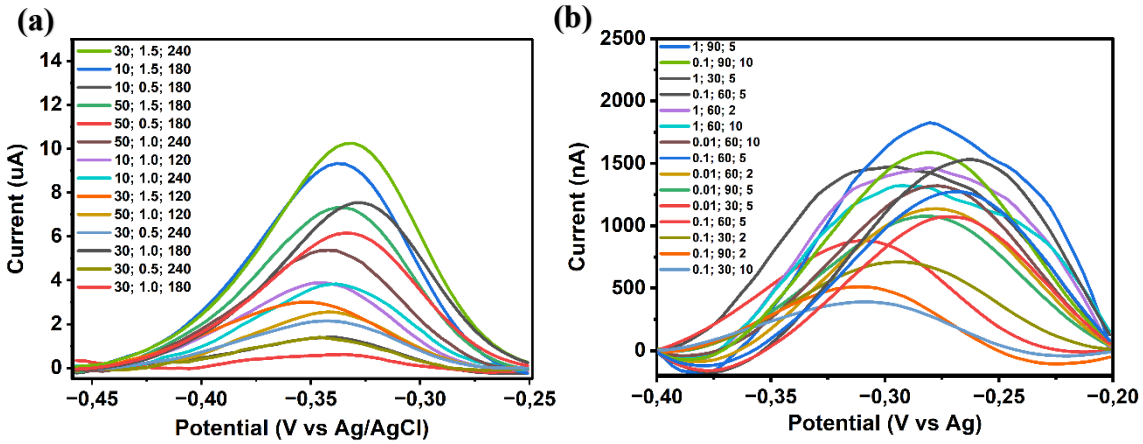

Fig S2. Voltamogram result from various 3 level combination parameter with BBD; (a) Immobilization of Probe ssDNA-MB; b) Detection of target with CRISPR/Cas12a trans-cleavage.

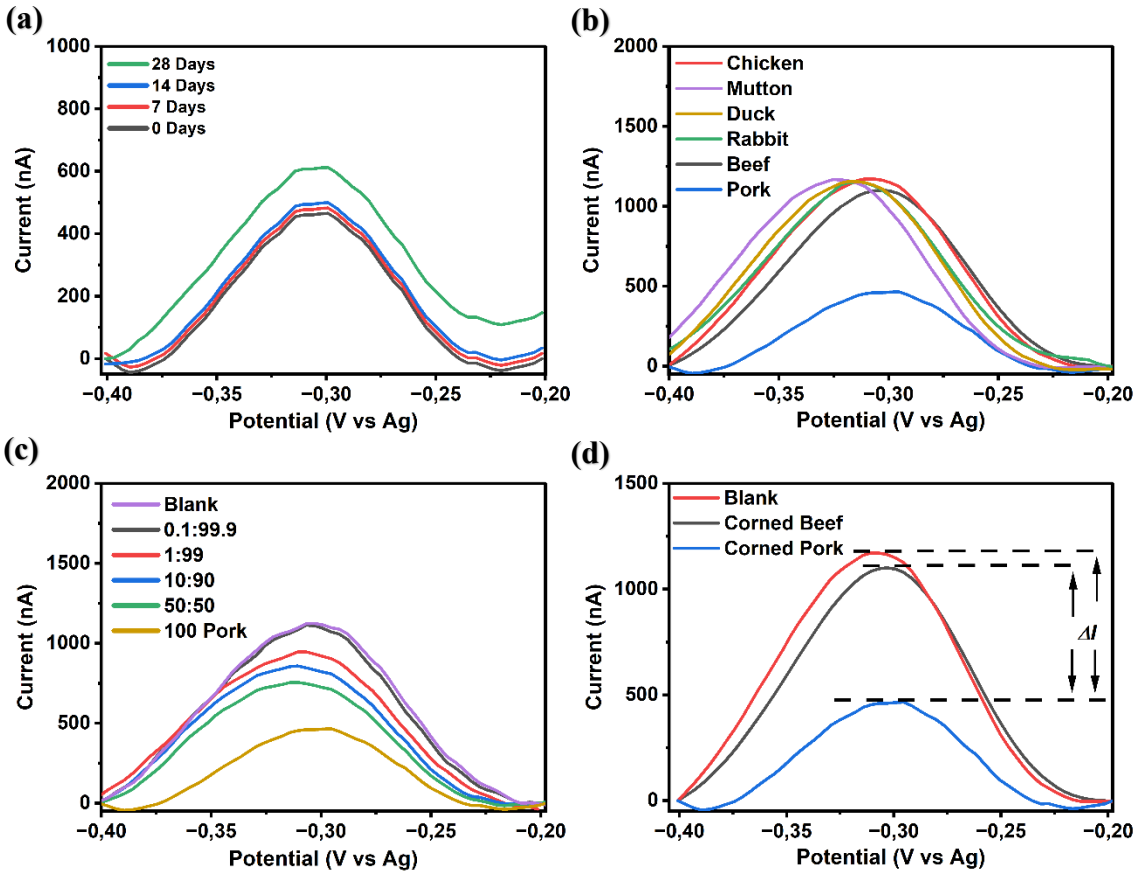

Fig S3. SWV voltamogram of (a) Stability of the modified electrode. Selectivity for (b) different species; (c) mixed sample; and (d) processed meat sample.

Table S1. Design experiments of BBD for optimization ssDNA probe immobilization

No	Parameters		
	STV Incubation Time (min)	Probe ssDNA-MB Concentration (µM)	Probe Incubation Time (min)
1	10	0.5	180
2	50	0.5	180
3	10	1.5	180
4	50	1.5	180
5	10	1.0	120
6	50	1.0	120
7	10	1.0	240
8	50	1.0	240
9	30	0.5	120
10	30	1.5	120
11	30	0.5	240
12	30	1.5	240
13	30	1.0	180
14	30	1.0	180
15	30	1.0	180

Table S2. Design experiments of BBD for optimization target detection

No	Parameters			
	BSA Concentration (%)	Target Incubation Time (min)	Target (uL)	Volume
1	1	30	5	
2	0.01	30	5	
3	1	90	5	
4	0.01	90	5	
5	1	60	2	
6	0.01	60	2	
7	1	60	10	
8	0.01	60	10	
9	0.1	30	2	
10	0.1	90	2	
11	0.1	30	10	
12	0.1	90	10	
13	0.1	60	5	
14	0.1	60	5	
15	0.1	60	5	

Table S3. Optimum parameter experiments

No	Parameter	Optimum	P-Value (95% Confident Level)
1	STV Incubation Time	30 min	0.509 (not significant)
2	Probe ssDNA-MB Concentration	1.5 uM	0.004 (very significant)
3	Probe Incubation Time	240 min	0.067 (slightly significant)
4	BSA Concentration	0.1%	0.008 (very significant)
5	Target Incubation Time	30 min	0.036 (slightly significant)
6	Target Volume	2 uL	0.861 (not significant)

Coefficient of the response function in the following equation:

$$Y = 6{,}8895 - 0{,}3825\ X_1 + 30{,}745\ X_2 + 13{,}155\ X_3 - 117{,}525\ X_1^2 - 0{,}88525\ X_2^2 - 175{,}425\ X_3^2 - 0{,}2915\ X_1 X_2 + 0{,}7305\ X_1 X_3 + 1{,}606\ X_2 X_3 \quad [1]$$

X_1: STV incubation time

X_2: probe concentration

X_3: probe incubation time

$$Y = 1564 - 929.5\ X_1 + 626\ X_2 + 40.5\ X_3 + 938.62\ X_1^2 - 235.38\ X_2^2 - 550.88\ X_3^2 - 732.75\ X_1X_2 + 324.75\ X_1X_3 + 235.25\ X_2X_3 \quad [2]$$

X_1: BSA concentration

X_2: target incubation time

X_3: target volume