

Article

Full Factorial Design Synthesis of Silver Nanoparticles Using *Origanum vulgare*

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Supporting Information

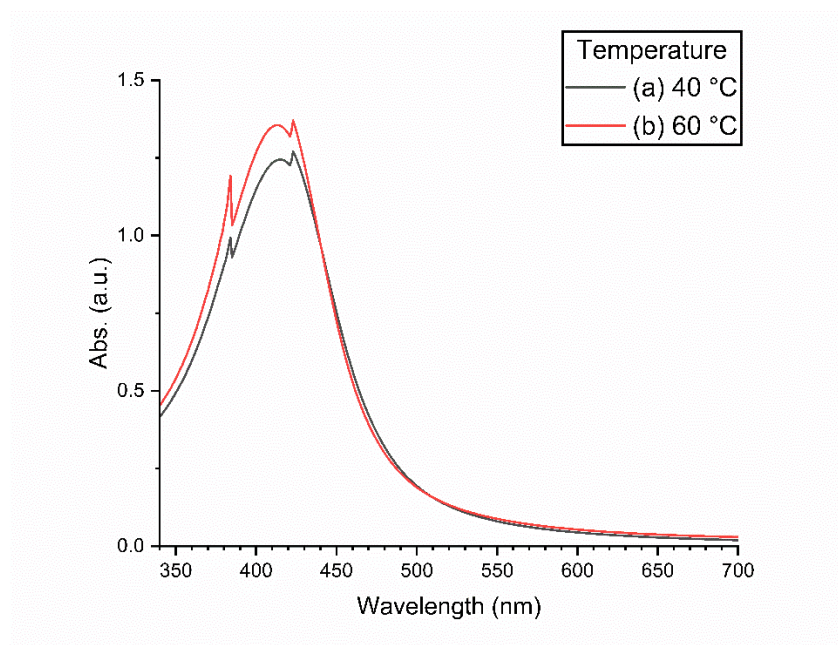


Figure S1. Effect of incubation temperature on UV – Vis spectra: (a) 40 °C, (b) 60 °C. AgNO₃ concentration 1 mM, OE concentration 2 % v/v, NaOH concentration 2mM, and incubation time 10 min.

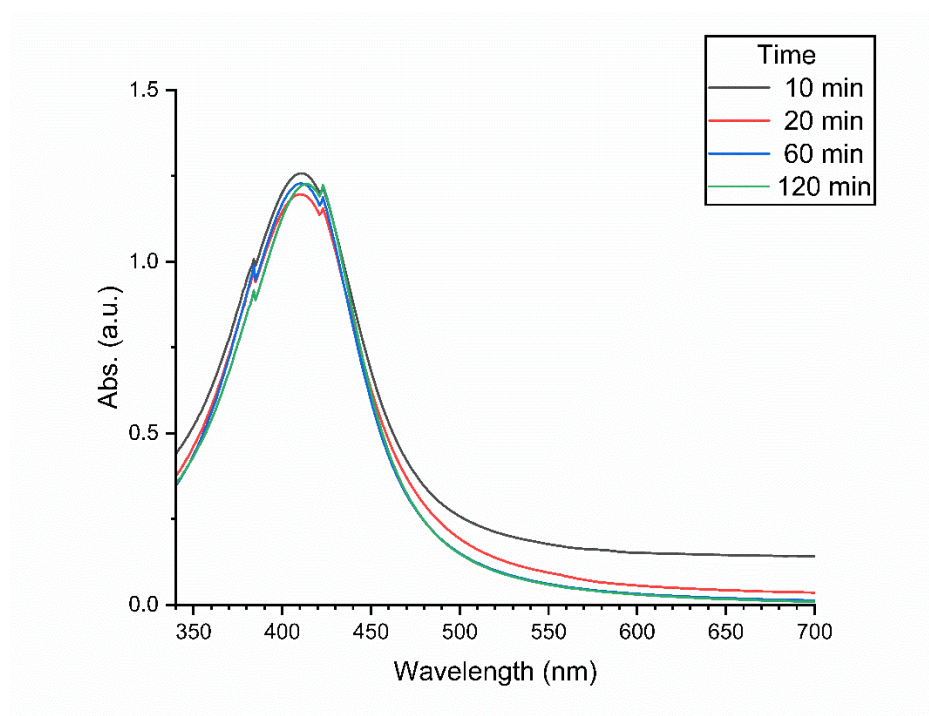


Figure S2. Effect of incubation time on UV – Vis spectra. AgNO_3 concentration 1 mM, OE concentration 2 % v/v, NaOH concentration 2 mM, and incubation temperature 60 °C.

Table S1. Fitting parameters of a Voigt function (λ_0 , A and FWHM) discussed in text, for UV – Vis spectra at different incubation temperatures and times. AgNO_3 concentration 1 mM, OE concentration 2 % v/v, and NaOH concentration 2 mM.

Temperature (°C)	Time (min)	λ_0 (nm)	A (a.u.)	FWHM (nm)
40	10	410.9	156.5	95.3
	20	408.1	161.5	90.8
60	10	408.0	128.6	86.0
	20	407.8	148.4	90.0
	60	407.5	142.8	86.3
	120	409.5	143.6	86.0

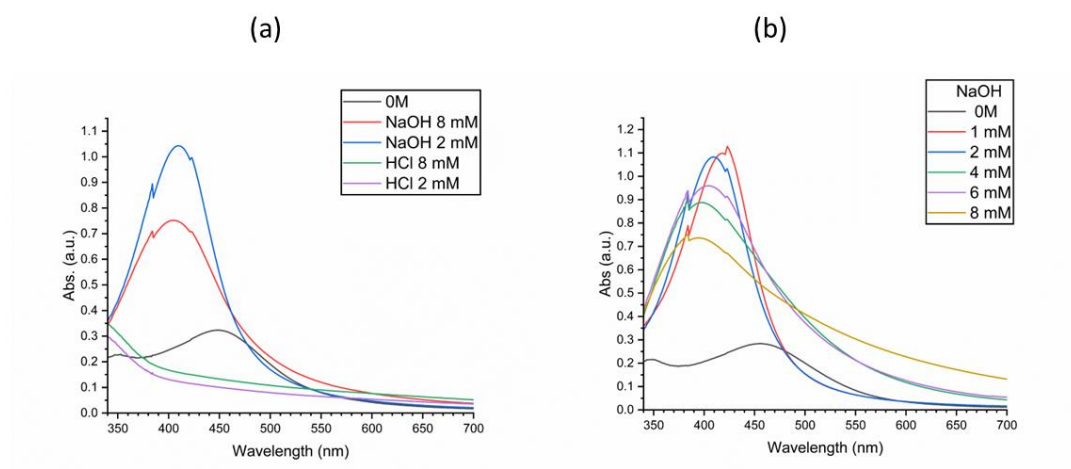


Figure S3. Effect of NaOH or HCl concentration on UV – Vis spectra. a) Coarse investigation, b) Fine tuning. AgNO_3 concentration 1 mM, OE concentration 2 % v/v, incubation temperature 60 °C, and incubation time 1 h.

Table S2. Fitting parameters of a Voigt function (λ_0 , A and FWHM) discussed in text, for UV – Vis spectra at different NaOH concentrations. AgNO_3 concentration 1 mM, OE concentration 2 % v/v, incubation temperature 60 °C, and incubation time.

NaOH concentration (mM)	λ_0 (nm)	A (a.u.)	FWHM (nm)
0	466.5	14.7	92.4
1	412.7	133.8	90.8
2	406.9	134.3	91.1
4	406.2	232.5	165.7
6	406.3	213.3	142.8
8	402.1	179.6	188.8

Table S3. Fitting parameters of a Voigt function (λ_0 , A and FWHM) discussed in text, for UV – Vis spectra at different OE and AgNO_3 concentrations. NaOH concentration 1 mM, incubation temperature 60 °C, and incubation time 1h.

OE concentration (% v/v)	AgNO_3 concentration (mM)	λ_0 (nm)	A (a.u.)	FWHM (nm)
0.8		413.5	116.6	90.1
2	1	412.5	143.6	92.6
4		410.2	154.2	103.3
	0.5	407.2	78.7	103.9
	1	410.2	119.2	95.5
2	1.5	414.9	151.9	95.9
	2	417.9	176.6	101.5

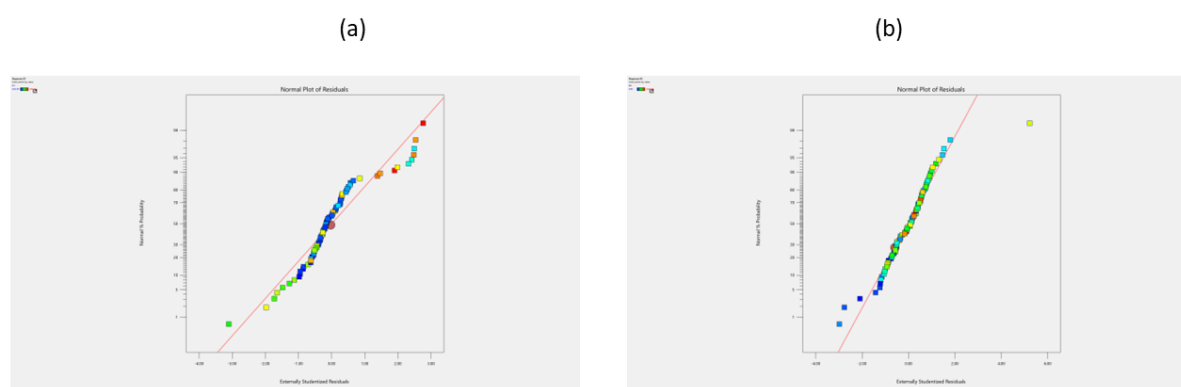


Figure S4. Normal probability plot of the residuals a) wavelength at peak maximum λ_0 , and b) peak area A.

Table S4. Pareto analysis [1] for significant terms (p-value < 0.05) in quadratic model for particle size [2] and cubic model for the peak wavelength λ_0 [3].

Particle size ^[2]		Peak wavelength λ_0 ^[3]	
Term	Per. Ef (%)	Term	Per. Ef (%)
AgNO ₃	0.39	BPE	0.71
GA	2.44	AgNO ₃	1.25
pH	96.88	time	0.11
GA*pH	<0.01	pH	10.45
AgNO ₃ ²	<0.01	BPE*pH	4.17
GA ²	0.01	AgNO ₃ *time	0.99
pH ²	0.29	AgNO ₃ *pH	1.10
-	-	BPE ²	12.75
-	-	BPE ² *pH	59.14
		AgNO ₃ *time*pH	2.83

Per. Ef = Percentage Effect; AgNO₃ concentration; GA = Gallic Acid concentration; BPE = Banana Peel Extract concentration

References

- [1] Asadzadeh, F.; Maleki-Kaklar, M.; Soiltanlinejad, N.; Shabani, F. Central Composite Design Optimization of Zinc Removal from Contaminated Soil, Using Citric Acid as Biodegradable Chelant. *Sci Rep*, **2018**, *8* (1). <https://doi.org/10.1038/s41598-018-20942-9>.
- [2] Ahani, M.; Khatibzadeh, M. Size Optimisation of Silver Nanoparticles Synthesised by Gallic Acid Using the Response Surface Methodology. *Micro Nano Lett*, **2020**, *15* (6), 403–408. <https://doi.org/10.1049/mnl.2019.0780>.
- [3] Rigopoulos, N.; Thomou, E.; Kouloumpis, A.; Lamprou, E. R.; Petropoulea, V.; Gournis, D.; Poullos, E.; Karantonis, H. C.; Giaouris, E. Optimization of Silver Nanoparticle Synthesis by Banana Peel Extract Using Statistical Experimental Design, and Testing of Their Antibacterial and Antioxidant Properties. *Curr Pharm Biotechnol*, **2019**, *20* (10), 858–873. <https://doi.org/10.2174/1389201020666181210113654>.