

Supplementary material

Chemical Profile of the Volatile Constituents and Antimicrobial Activity of the Essential Oils from *Croton adipatus*, *Croton thurifer*, and *Croton collinus*

Juana Liz Cucho-Medrano ¹, Sammy Wesley Mendoza-Beingolea ¹, César Máximo Fuertes-Ruitón ², María Elena Salazar-Salvatierra ³, and Oscar Herrera-Calderón ^{4,*}

¹ Faculty of Pharmacy and Biochemistry, Universidad Nacional Mayor de San Marcos, Jr. Puno 1002, Lima 15001, Peru; liz.cumed@gmail.com (J.L.C.-M.), sammy_w20@outlook.com (S.W.M.-B.)

² Institute for Research in Pharmaceutical Sciences and Natural Resources, Faculty of Pharmacy and Biochemistry, Universidad Nacional Mayor de San Marcos, Jr. Puno 1002, Lima 15001, Peru; cfuertesr@unmsm.edu.pe

³ Research Institute in Biological Chemistry, Microbiology and Biotechnology, Faculty of Pharmacy and Biochemistry, Universidad Nacional Mayor de San Marcos, Jr. Puno 1002, Lima 15001, Peru; msalazars@unmsm.edu.pe

⁴ Department of Pharmacology, Bromatology and Toxicology, Faculty of Pharmacy and Biochemistry, Universidad Nacional Mayor de San Marcos, Jr. Puno 1002, Lima 15001, Peru. oherreraca@unmsm.edu.pe

* Correspondence: oherreraca@unmsm.edu.pe; Tel.: (+51-956-550-510)

Supplementary material	Pag.
Figure S1. GC-MS chromatogram of the essential oil of <i>Croton adipatus</i> Kunth.	3
Figure S2. Spectrum of the main constituents of the essential oil of <i>Croton adipatus</i> Kunth. A: β -myrcene; B: α -thujene; C: D-Limonene.	3
Figure S3. GC-MS chromatogram of the essential oil of <i>Croton thurifer</i> Kunth.	3
Figure S4. Spectrum of the main constituents of the essential oil of <i>Croton thurifer</i> Kunth. A: Unknown ($C_{10}H_{16}$); B: Unknown ($C_{15}H_{26}O$); C: β -elemene.	4
Figure S5. GC-MS chromatogram of the essential oil of <i>Croton collinus</i> Kunth.	4
Figure S6. Spectrum of the main constituents of the essential oil of <i>Croton collinus</i> Kunth. A: β -caryophyllene B: D-limonene; C: β -thujene.	4
Table S1. Physicochemical properties of the essential oils of <i>Croton</i> species.	5
Table S2. Retention times of the chemical compounds of <i>Croton adipatus</i> Kunth essential oil.	6

Table S3. Retention times of the chemical compounds of <i>Croton thurifer</i> Kunth essential oil.	8
Table S4 Retention times of the chemical compounds of <i>Croton collinus</i> Kunth essential oil.	9
Figure S7. Determination of the Minimum Inhibitory Concentration of the standard drugs. SC (Sterility Control), GC (Growth Control), Sa (<i>S. aureus</i>), Bs (<i>B. subtilis</i>), Ec (<i>E. coli</i>), Pa (<i>P. aeruginosa</i>), Ca (<i>C. albicans</i>).	10

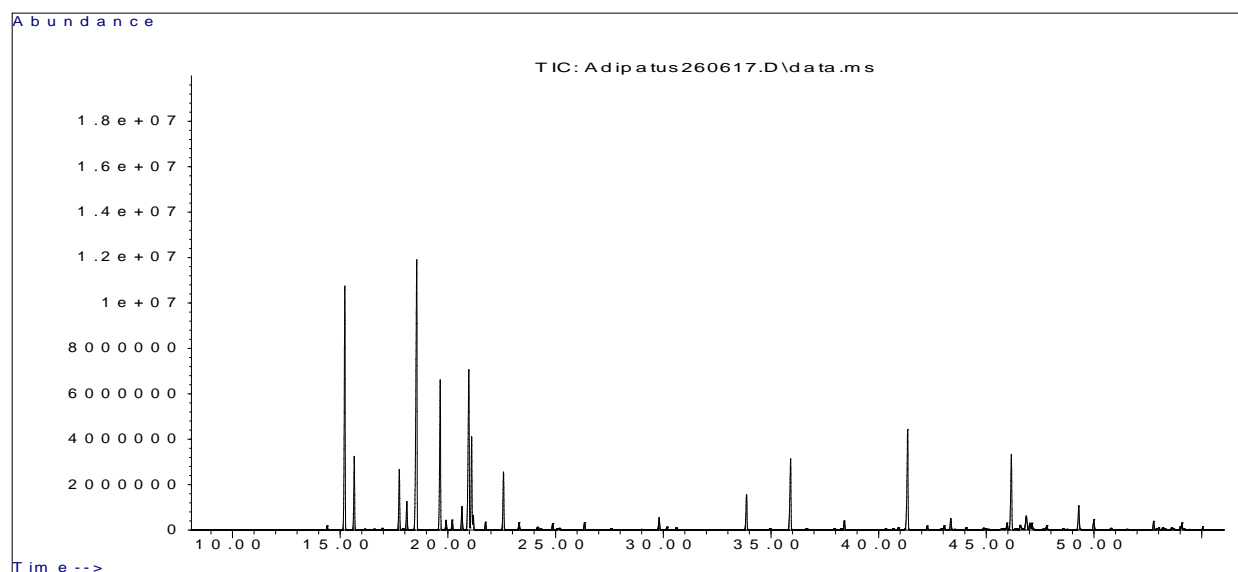


Figure S1. GC-MS chromatogram of the essential oil of *Croton adipatus* Kunth.

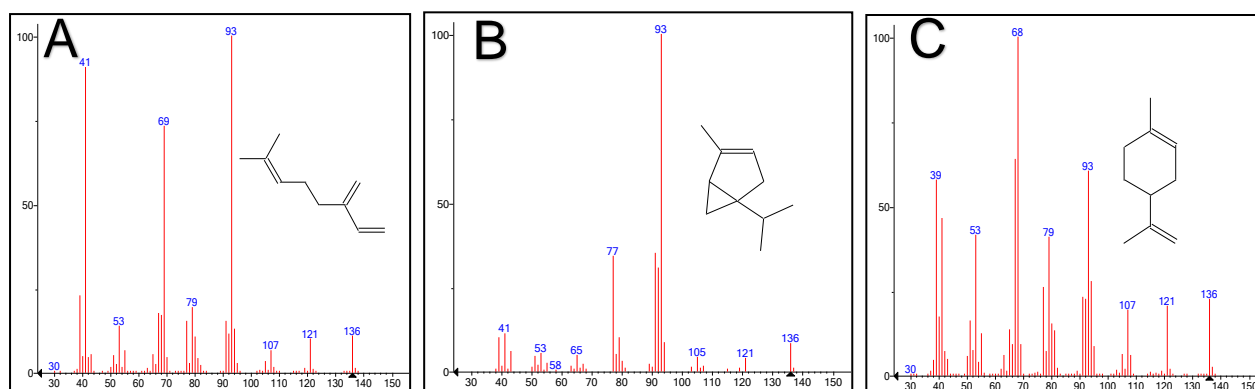


Figure S2. Spectrum of the main constituents of the essential oil of *Croton adipatus* Kunth.
A: β -myrcene; B: α -thujene; C: D-Limonene.

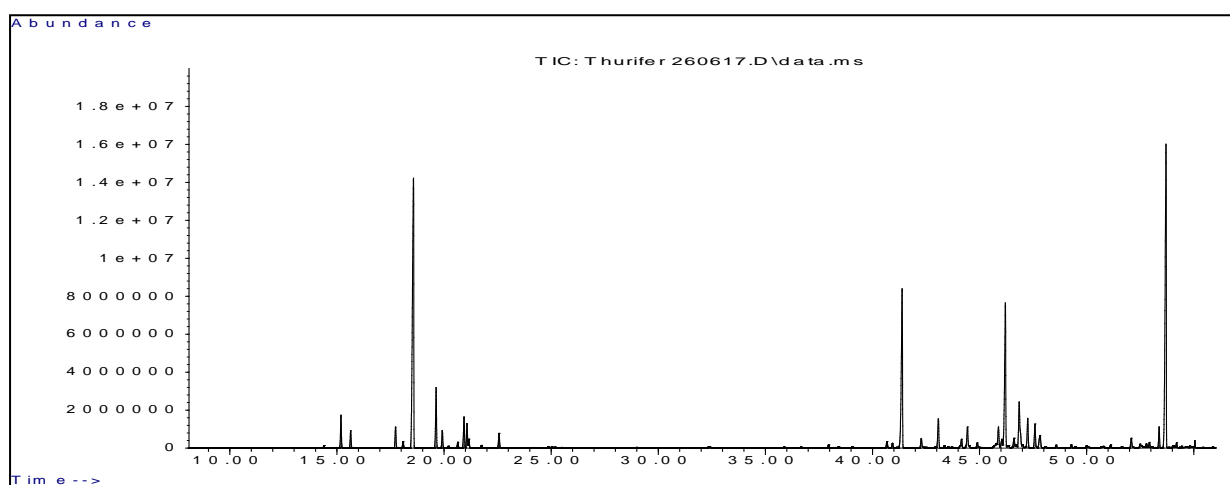


Figure S3. GC-MS chromatogram of the essential oil of *Croton thurifer* Kunth.

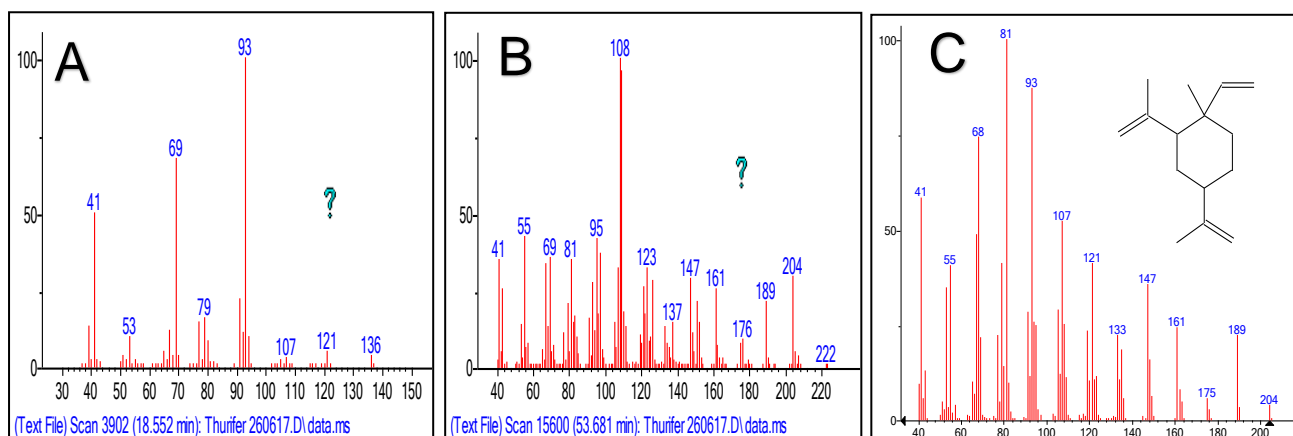


Figure S4. Spectrum of the main constituents of the essential oil of *Croton thurifer* Kunth.
A: Unknown ($C_{10}H_{16}$); B: Unknown ($C_{15}H_{26}O$); C: β -elemene.

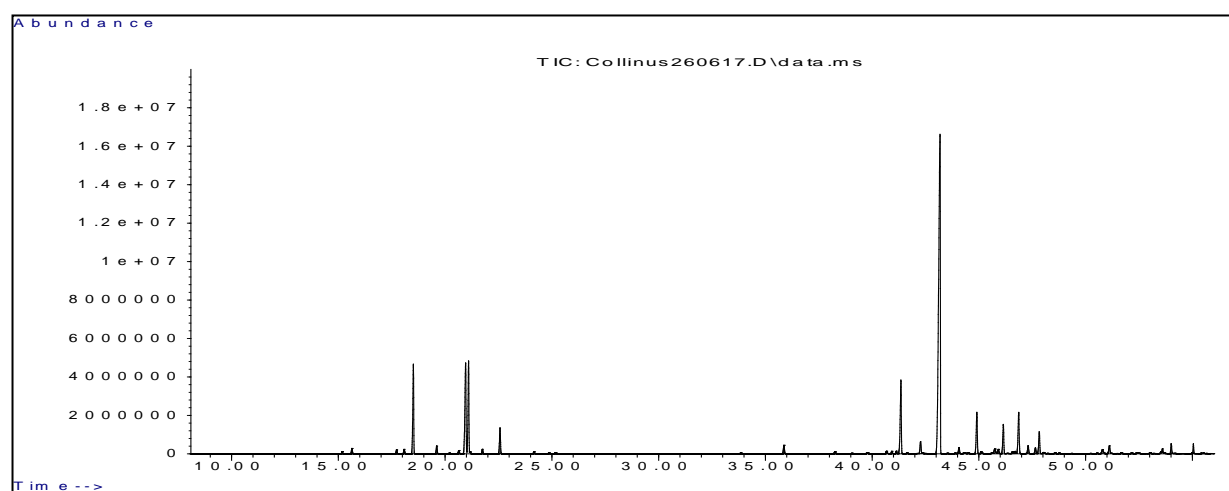


Figure S5. GC-MS chromatogram of the essential oil of *Croton collinus* Kunth.

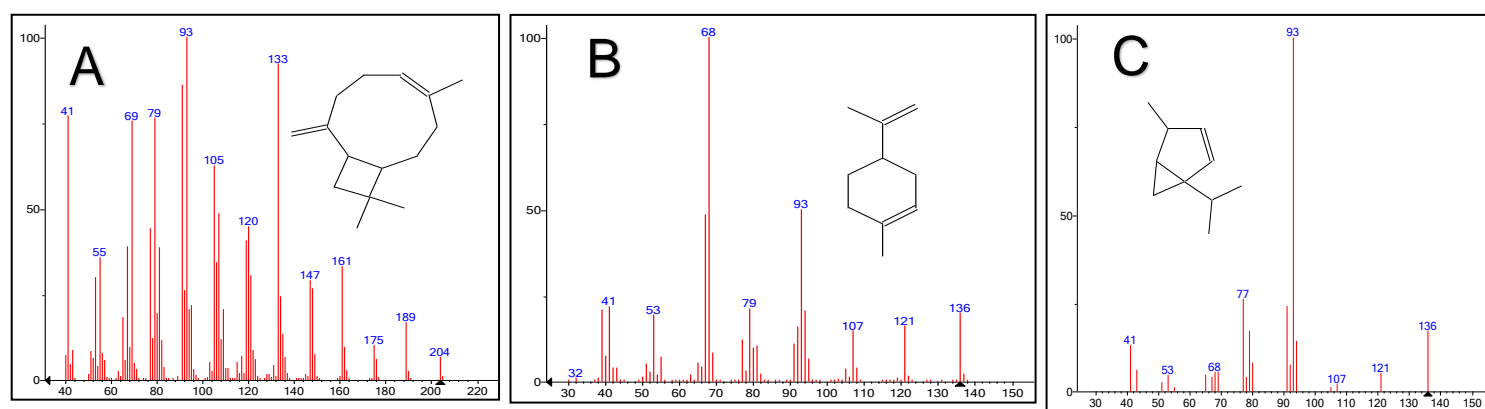


Figure S6. Spectrum of the main constituents of the essential oil of *Croton collinus* Kunth.
A: β -caryophyllene B: D-limonene; C: β -thujene.

Table S1. Physicochemical properties of the essential oils of Croton species.

	<i>Croton adipatus</i> Kunth	<i>Croton thurifer</i> Kunth	<i>Croton collinus</i> Kunth
Solubility	Insoluble in water and ethanol 50%, soluble in methanol, DMSO and absolute ethanol.	Insoluble in water and ethanol 50 %, soluble in methanol, DMSO and absolute ethanol.	Insoluble in water and ethanol 50 %, soluble in methanol, DMSO and absolute ethanol.
Density (25°C)	0.9064 g/mL	0.9371 g/mL	0.9117 g/mL
Refractive index (20°C)	1.4715	1.4800	1.4845
Yield (%)	0.47± 0.01	0.07± 0.005	0.06 ± 0.001

Table S2. Chemical composition of *Croton adipatus* Kunth essential oil.

N°	Chemical constituents	Rt (min)
1	Isobutyl isobutyrate	14.39
2	α -thujene	15.22
3	α -Pinene	15.65
4	Sabinene	17.74
5	β -Pinene	18.09
6	β -Myrcene	18.55
7	α -Phellandrene	19.65
8	Isoamyl isobutyrate	19.92
9	α -Terpinene	20.20
10	o-Cymene	20.65
11	D-Limonene	20.97
12	β -Phellandrene	21.11
13	Eucalyptol	21.18
14	cis-Ocimene	21.75
15	τ -Terpinene	22.58
16	β -Terpineol	23.31
17	Terpinolene	24.16
18	β -Linalool	24.87
19	1,6-Dimethylhepta-1,3,5-triene	26.35
20	4-Terpineol	29.81
21	2-Decanone	30.17
22	α -Terpineol	30.60
23	2-Undecanone	33.87
24	2-Dodecanone	35.91
25	2-Carene	38.41
26	Unknown (C ₁₅ H ₂₄)	40.92
27	β -Elemene	41.35
28	2-Ethyl-1,3-dimethyl-Benzene	42.26
29	β -Caryophyllene	43.05
30	δ -Elemene	43.35
31	Nerylacetone	44.07
32	α -Muurolene	45.97
33	Germacrene D	46.17
34	α -Selinene	46.58
35	Bicyclogermacrene	46.86
36	Geranyl isobutyrate	47.02
37	δ -Cadinene	47.12
38	Unknown (C ₁₅ H ₂₄)	47.81
39	Elemol	49.29
40	Unknown (C ₁₅ H ₂₄)	49.99
41	Unknown (C ₁₅ H ₂₆ O)	52.77
42	β -Maaliene	53.19

43	Unknown (C ₁₅ H ₂₆ O)	53.60
44	τ-Muurolol	54.01
45	Unknown (C ₁₅ H ₂₆ O)	54.08
46	Heptadecane	55.05

Table S3. Chemical composition of *Croton thurifer* Kunth essential oil.

N°	Chemical constituents	Rt (min)
1	α -Thujene	15.19
2	α -Pinene	15.64
3	Sabinene	17.74
4	β -Pinene	18.09
5	Unknown (C ₁₀ H ₁₆)	18.57
6	α -Phellandrene	19.63
7	Isopentyl isobutyrate	19.92
8	p-Cymene	20.64
9	D-Limonene	20.93
10	β -Phellandrene	21.07
11	Eucalyptol	21.16
12	1-methyl-4-(1-methylethyl)-1,4-cyclohexadiene	22.57
13	Copaene	40.68
14	1-ethenyl-1-methyl-2,4-bis (1-methylethenyl)-cyclohexane	40.93
15	β -Elemene	41.39
16	Cyperene	42.28
17	β -Caryophyllene	43.08
18	Unknown (C ₁₅ H ₂₄)	44.16
19	L-Alloaromadendrene	44.44
20	α -Caryophyllene	44.89
21	α -Elemene	45.77
22	Unknown (C ₁₅ H ₂₄)	45.88
23	Unknown (C ₁₅ H ₂₄)	46.04
24	Germacrene D	46.21
25	Eremophilene	46.61
26	Unknown (C ₁₅ H ₂₆ O)	46.85
27	Unknown (C ₁₅ H ₂₆ O)	47.59
28	δ -Cadinene	47.83
29	Unknown (C ₁₅ H ₂₆ O)	52.08
30	Unknown (C ₁₅ H ₂₂ O)	52.93
31	Unknown (C ₉ H ₁₄ O)	53.39
32	Unknown (C ₁₅ H ₂₆ O)	53.70
33	Unknown (C ₁₅ H ₂₆ O)	54.20
34	Heptadecane	55.06

Table S4. Chemical composition of *Croton collinus* Kunth essential oil.

N°	Chemical constituents	Rt (min)
1	α -Thujene	15.18
2	α -Pinene	15.64
3	Sabinene	17.73
4	β -Pinene	18.08
5	β -Myrcene	18.51
6	α -Phellandrene	19.61
7	p-Cymene	20.64
8	D-Limonene	20.96
9	β -Thujene	21.10
10	cis-Ocimene	21.75
11	1-methyl-4- (1-methylethyl) -1,4-cyclohexadiene	22.57
12	Terpinolene	24.16
13	2-Undecanone	35.87
14	1,5,5-Trimethyl-6-methylene-cyclohexene	38.25
15	Copaene	40.68
16	Unknown (C ₁₅ H ₂₄)	40.93
17	Unknown (C ₁₅ H ₂₄)	41.13
18	β -Elemene	41.35
19	Cyperene	42.27
20	β -Caryophyllene	43.18
21	Geranyl acetone	44.07
22	α -Caryophyllene	44.91
23	Aromadendrene	45.10
24	Valencene	45.74
25	α -Curcumene	45.91
26	Germacrene D	46.15
27	α -Selinene	46.57
28	β -Cubebene	46.70
29	Bicyclogermacrene	46.87
30	Unknown (C ₁₅ H ₂₄)	47.31
31	α -Muurolene	47.65
32	δ -Cadinene	47.83
33	(-)-Spatulenol	50.79
34	Unknown (C ₁₅ H ₂₄ O)	51.12
35	τ -Muurolene	53.53
36	τ -Muurolol	53.60
37	α -Cadinol	54.01
38	Heptadecane	55.05

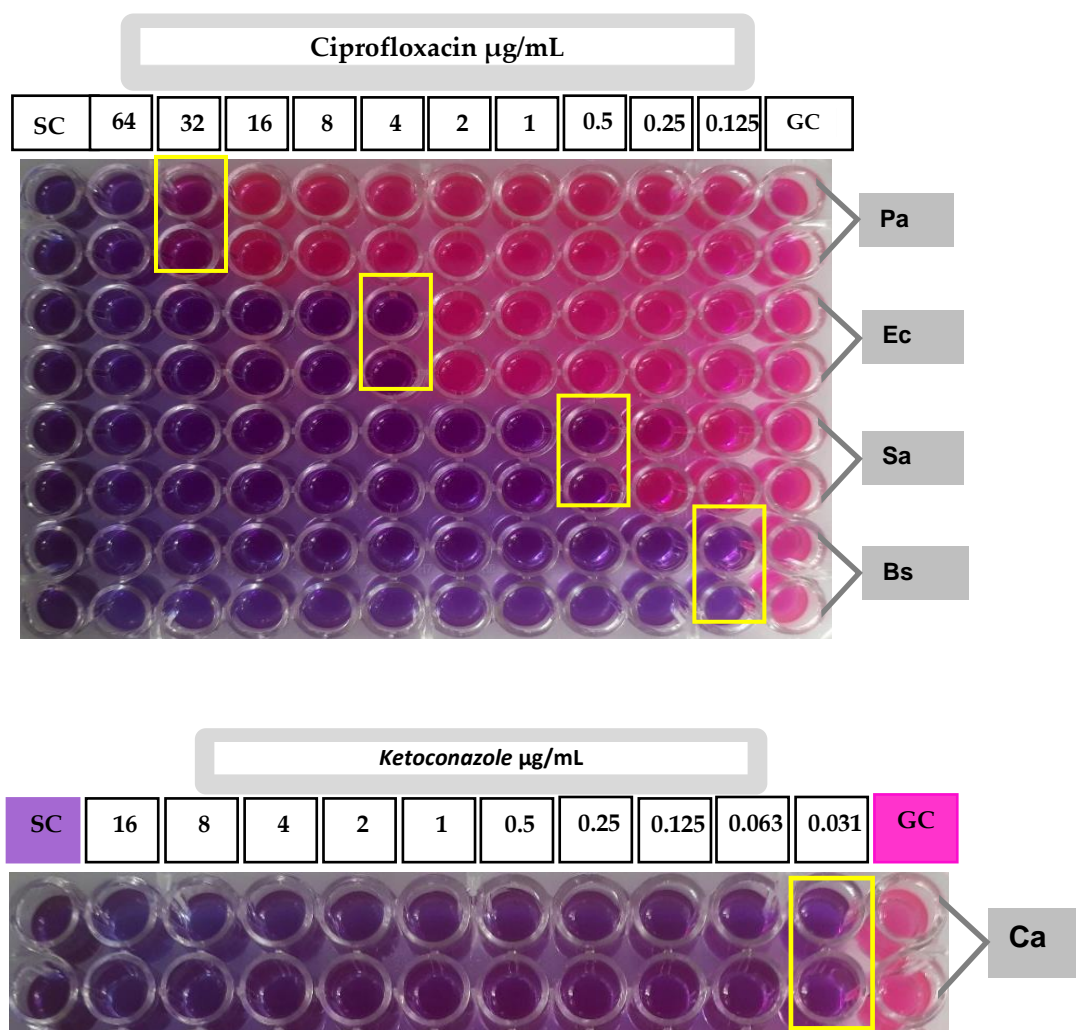


Figure S7. Determination of the Minimum Inhibitory Concentration of the standard drugs. SC (Sterility Control), GC (Growth Control), Sa (*S. aureus*), Bs (*B. subtilis*), Ec (*E. coli*), Pa (*P. aeruginosa*), Ca (*C. albicans*).