Increased use of antiseptics due to COVID19: a case study in Greece - anticipated effects on the marine environment

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Abstract COVID19 pandemic started in China in 2019, when a coronavirus appeared that spread globally, causing severe health problems and increasing mortality. At that time, as there were no effective phamaceuticals for treatment and no vaccines for protection, the only available means were preventive measures: antiseptics and masks. There has been a dramatic increase in their use, for human protection. However, the final receiver of all substances contained in antiseptics is the marine environent, where adverse effects could appear, degrading its quality, affecting marine organisms, and eventually, human. This paper reports the first study in Greece regarding the quantities of antiseptics used before and after COVID19 outbreak, in order to estimate their increase, while in parallel, an investigation of ingredients of antiseptics and their possible toxic effects was performed, in order to provide a primary picture of anticipated future effects of their increased use on the marine environment.

Keywords: COVID19, antiseptics, ingredients, toxicity, marine environmental effects

1. Introduction

1.1 COVID19 pandemic - antiseptics

COVID19 pandemic started in China in 2019, when the easily-spreading coronavirus SARS-CoV-2 (Fig. 1) appeared, causing problems in human respiratory system. Its effects can be severe and lead to death (Gorbalenya et al., 2020). At that time, there were no pharmaceuticals for treatment and no vaccines for prevention, while a global race started in order to develop them as soon as possible (Hassan, 2020, CDC, 2020).

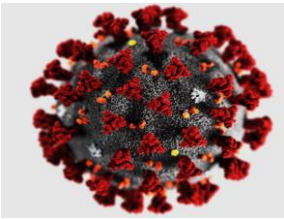

Figure 1. SARS-CoV-2 (University of Athens, 2020)

COVID19 spread very fast, in spite of preventive measures and lockdowns, in many countries. The result was a pandemic that increased average human mortality (Velavan et al., 2020).

Due to lack of effective pharmaceuticals for COVID19 treatment and with no vaccines developed for its prevention, the only available means of protection were preventive measures: antiseptics and masks. As a result, there has been a dramatic increase in their use, for human protection. However, the final receiver of all substances contained in antiseptics is the marine environent, where adverse effects could appear, degrading its quality, affecting marine organisms, and eventually, human.

Antiseptics are antimicrobial substances, which, when present on a live tissue-skin, reduces the possibility of infection. Some antiseptics are capable of destroying microorganisms, while others are bacteriostatic, limiting their growth (Gorbalenya et al., 2020, Ελληνική Εταιρία Επείγουσας Ιατρικής, 2020). Types of antiseptics available in the market are liquids, gel and hankies. Most of them contain some form of alcohol as antiseptic agent, but several other substances are included in their ingredients (Fig. 2)

Figure 2. Antiseptics as preventive measures for COVID19 – concerns for the marine environment

As the demand and use of antiseptics for protection from COVID19 rapidly grows, so do their ingredients that eventually reach the environment and marine ecosystems via direct or indirect pathways. Some of the substances contained in antiseptics can be harmful or have toxic

effects. They can evaporate and reach marine environment during air-sea interactions or via precipitation. They can also be transferred to the marine environment from the ground, via groundwater, sediment transfer or other geological processes, as well as via treated wastewater, where their removal percentages have not yet been fully investigated.

This paper reports the results of the first study in Greece regarding the quantities of antiseptics used before and after COVID19 outbreak, in order to estimate their increase, while in parallel, an investigation of ingredients of antiseptics and their possible toxic effects was performed, in order to provide a primary picture of anticipated future effects of their increased use on the marine environment.

2. Materials and methods

2.1. Data collection for amounts of antiseptics used in Greece before and after COVID19 outbreak

Data collection in regard to the amounts of antiseptics used in Greece was difficult and time consuming at that time, due to restrictions and lockdowns during pandemic outbreak. Information was initially collected by visits to hospitals, pharmacies and supermarkets, in several cities in Greece, where the amounts of sales and/or use of antiseptics (in different forms, i.e. liduid, gel, hankies) were recorded monthly from November 2019 to June 2020, covering time intervals before and after COVID19 outbreak in Greece. Additional data was afterwards collected from more locations, by creation and emailing of a questionnaire to phamacies, antiseptic companies, supermarkets, hospitals etc.

2.2. Investigation of substances contained in antiseptics and their environmental/toxic effects

For data collection in regard to the substances contained in antiseptics, a field research was conducted via screenshots of antiseptics packagings. Screenshots were collected from various places in Greece, from shops selling antiseptics (pharmacies, supermarkets, mini markets) as well as from various shops/services , e.g. banks, post offices, dentists, private companies, where antiseptics were provided to clients during entrance to the building, from hospitals (used by personnel and patients), and from people who carried them for personal use in the car or at home.

Afterwards, the ingredients on the labels were recorded, creating a list with all substances, as well as the number of times of detection of each substance in total and in each category of antiseptics (liquids, gels, hankies). classification of each substance as well as an indicator showing its classification based on the anticipated.

Each substance was then entered in the database created by Environmental working group (www.ewg.org) in order to obtain information on their effects (e.g. toxicity). The results were presented in a table indicating the environmental problems it can cause and its effects on organisms.

3. Results and discussion

The total increase of the use of antiseptics was calculated to be 10,5 times greater during COVID19 outbreak in Greece, compared to that before (Table 1). Table 1 provides detailed results regarding the amounts and types of antiseptics used in various locations and sectors in Greece. The anticipated environmental effects of increased antiseptics used depend on the toxicity/adverse effects of their ingredients, which are presented in detail in Table 2 and Figure 3.

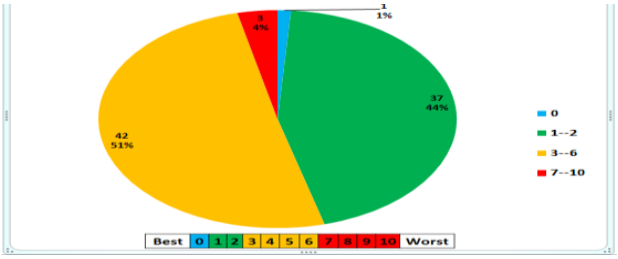

Figure 3. Overall classsification of substances according to their anticipated environmental effects

96 substances were detected in the screenshots collected, 42 of which were medium-risk and 3 high-risk. Given the rapidly growing antiseptics use and relevant compound release eventually in the marine environment, close monitoring is necessary in order to safequard its quality and human health.

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Ελληνική Εταιρεία Επείγουσας Ιατρικής Κατευθυντήριες οδηγίες για τη νόσο του κορωνοϊού SARS-CoV-2 (νόσο COVID-19)

Table 1. Use of antiseptics in Greece before and after COVID19 outbreak

Category	Area/city	Estimated monthly consumption of antiseptics from the seller before COVID-19	Estimated monthly consumption of antiseptics from the seller after COVID-19	Type of antiseptics	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020	May 2020	June 2020
Company of antiseptics	Athens	0	300+	Gel	0	0	0	1000	2000	2000	1000	300
Pharmacy	Didymoteixo	1--10	51--100	Gel	8	7	11	50	102	45	22	14
Pharmacy	Limnos	11--50	51--100	Gel , Liquids	10	10	12	15	250	200	70	70
Pharmacy	Limnos	1--10	51--100	Hankies Gel	12	8	6	8	40	48	82	44
Pharmacy	Limnos	1--11	101--300	Hankies Gel , Liquids	3	8	25	130	296	305	146	84
Company of antiseptics	Athens	300+	300+	Hankies Gel , Liquids	2000	2500	4000	10000	40000	120000	120000	120000
Pharmacy	Limnos	1--10	11--50	Hankies Gel	20	20	22	18	120	130	100	100
Pharmacy	Limnos	11--50	101--300	Hankies Gel	30	20	20	20	150	170	150	100
Other	Thessaloniki	11--50	51--100	Hankies Gel , Liquids	5	3	7	8	55	20	10	2
Pharmacy	Lesvos	1--10	51--100	Liquids	15	15	15	50	70	70	80	50
Pharmacy	Lesvos	1--10	11--50	Hankies Gel , Liquids	50	50	40	30	30	20	20	10
Pharmacy	Lesvos	0	11--50	Hankies	0	0	0	5	30	24	24	30
Pharmacy	Lesvos	1--10	11--50	Gel	5	5	10	20	50	50	40	20
Pharmacy	Lesvos	1--10	11--50	Hankies Gel, Liquids	2	2	1	6	50	20	10	5
Pharmacy	Lesvos	1--10	51--100	Gel, Liquids	8	7	12	28	43	58	45	49
Pharmacy	Lesvos	1--10	11--50	Gel, Liquids	2	10	0	0	20	20	10	10
Supermarket - Chain of shops	Athens	1--10	101--300	Hankies Gel, Liquids	12	10	5	12	215	305	485	386
Supermarket - Chain of shops	Athens	11--50	300+	Hankies Gel, Liquids	0	21	17	22	278	314	379	289
Supermarket - Chain of shops	Syros	0	51--100	Hankies Gel, Liquids	0	0	0	48	94	82	104	154
Supermarket - Chain of shops	Crete	1--10	300+	Hankies Gel, Liquids	9	8	10	71	109	298	305	439
Supermarket - Chain of shops	Paros	0	101--300	Hankies Gel, Liquids	0	0	0	0	60	72	166	298
Supermarket - Chain of shops	Leros	0	101--300	Hankies Gel, Liquids	0	0	0	39	99	138	155	206
Supermarket - Chain of shops	Rhodes	0	300+	Hankies Gel, Liquids	0	0	0	35	88	168	201	322
Supermarket - Chain of shops	Athens	1--10	101--300	Hankies Gel, Liquids	0	0	10	31	101	184	211	299
Supermarket - Chain of shops	Athens	11--50	300+	Hankies Gel, Liquids	9	18	29	69	164	215	311	406
Hospital	Limnos	11--50	51--100	Liquids	22	31	29	100	91	36	64	49
Supermarket - Chain of shops	Nafplio	0	101--300	Hankies Gel, Liquids	0	0	0	11	55	148	263	387
Supermarket - Chain of shops	Skopelos	0	300+	Hankies Gel, Liquids	0	0	0	0	22	58	126	287
Supermarket - Chain of shops	Lefkada	0	300+	Hankies Gel, Liquids	0	0	0	9	31	76	189	301
Supermarket - Chain of shops	Zakynthos	0	300+	Hankies Gel, Liquids	0	0	0	6	38	73	164	299
Supermarket - Chain of shops	Kefalonia	0	300+	Hankies Gel, Liquids	0	0	0	11	64	87	159	276
Supermarket - Chain of shops	Larisa	0	300+	Hankies Gel, Liquids	0	0	0	42	68	167	283	315
Supermarket - Chain of shops	Kastoria	0	101--300	Hankies Gel, Liquids	0	0	0	13	39	141	188	294
Supermarket - Chain of shops	Kalavryta	0	101--300	Hankies Gel, Liquids	0	0	0	7	22	136	176	293
Supermarket - Chain of shops	Kozani	0	300+	Hankies Gel, Liquids	0	0	0	8	55	130	218	309
Supermarket - Chain of shops	Florina	0	101--300	Hankies Gel, Liquids	0	0	0	0	31	45	146	279
Supermarket - Chain of shops	Salamina	0	300+	Hankies Gel, Liquids	0	0	0	42	89	149	255	326
Supermarket - Chain of shops	Antiparos	0	101--300	Hankies Gel, Liquids	0	0	0	0	12	55	139	218
Supermarket - Chain of shops	Marathonas	0	101--301	Hankies Gel, Liquids	0	0	0	0	19	35	143	217
Supermarket - Chain of shops	Katerini	0	101--300	Hankies Gel, Liquids	0	0	0	21	111	154	223	304
Supermarket - Chain of shops	Thessaloniki	0	300+	Hankies Gel, Liquids	0	0	41	144	202	306	336	510
Supermarket - Chain of shops	Athens	1--10	300+	Hankies Gel, Liquids	9	12	23	52	86	146	229	389
Supermarket - Chain of shops	Athens	1--10	300+	Hankies Gel, Liquids	12	19	26	84	115	228	306	399
Supermarket - Chain of shops	Athens	1--10	300+	Hankies Gel, Liquids	8	17	22	39	77	173	266	309
Supermarket - Chain of shops	Spetses	1--10	300+	Hankies Gel, Liquids	16	18	23	88	197	298	301	378
Supermarket - Chain of shops	Poros	0	101--300	Hankies Gel, Liquids	0	0	0	22	46	77	154	286
Supermarket - Chain of shops	Athens	0	300+	Hankies Gel, Liquids	0	0	12	29	155	264	302	322
Supermarket - Chain of shops	Kalamata	0	300+	Hankies Gel, Liquids	0	0	0	33	88	132	288	365
Supermarket - Chain of shops	Patra	0	300+	Hankies Gel, Liquids	0	0	0	31	98	199	247	312
Supermarket - Chain of shops	Aigio	0	300+	Hankies Gel, Liquids	0	0	0	22	98	152	239	301
Supermarket - Chain of shops	Crete	0	300+	Hankies Gel, Liquids	0	0	0	24	163	201	297	375
Supermarket - Chain of shops	Ydra	0	101--300	Hankies Gel, Liquids	0	0	0	5	32	134	215	304

Table 2. All substances (96) detected in screenshots of 52 antiseptics and their classification regarding toxic effects

Antiseptics substances	Detected	Cancer	Developmental & reproductive toxicity	Allergies and immunotoxicity	Indicator
1-Tetradecanol (Myristyl Alcohol)	1				1
Accorbic Acid	2	-	-	-	-
Acetylcedrene	1				1
Acrylates/C10-30 alkyl acrylate crosspolymer	11				1
Acrylic Copolymer	1				1--2
Alcohol	7				1
Alcohol denat.	17				1
Alkyl Acrylate Crosspolymer	2				1
Allantoin	2				1
Aloe Barbadensis	1				1--3
Aloe Barbadensis Leaf Extract	5				1--3
Aloe Barbadensis Leaf guice	3				1--3
Aloe Barbadensis Leaf guice Powder	2				1--3
Aloe Vera	3				1--3
Alpha-Isomethyl Ionone	1				3--5
Aminomethyl Propanol	7				1--3
Ammonium Acryloytafmethytaurate/VP Copolymer	1	-	-	-	-
Ammonium nonokynol-4-sulfate	1				1--3
Aqua (Water)	33				0
Benzoic Acid	3				1--3
Benzophenone	2				3
Benzyl Alcohol	4				4--6
Benzyl Benzoate	1				4--5
Benzyl Salicylate	6				3--5
Butylphenyl Methylpropional (Lilial)	8				5--7
Caprylyl Glycol	1				1
Carbomer	7				1
Cetylpyridinium Chloride	1				3--5
Chlorhexidine Digluconate	4				2--4
Chlorphenesin	1				2--3
CI 19140	2				4--6
CI 42051	6				1--3
CI 42090	3				2--7
Citric Acid	8				1--2
Citronellol	7				3--4
CI 60730	1				3--6
Cocamidopropyl Betaine	3				1--6
Coconut fatty acid diethanolamide (Cocamide DEA)	1				7
Coumarin	5				4--5
Decylene Glycol	1				1
Dehydroacetic Acid	3				1
Denatured ethanol	1				1
Disodium Cocoamphodiacetate	1				1
Disodium EDTA	4				1
Disodium Phosphate	1				1
D-Panthenol	1				1
Essential oil	1	-	-	-	-
Ethyl Alcohol	15				1
Eugenol	1				3--5
Flower DIstllate	1	-	-	-	-
Geraniol	3				3--5
Glycerin	26				1--2
Glycerol	1	-	-	-	-
Glyceryl monostearate	1				1
Hexyl Cinnamal	12				3
Isopropyl alcohol	4				2
Lauramide DEA	1				1--3
Lavandin Oil (Lavanduka Hybrida (Lavandin) Oil)	1				1
Lavender	1	-	-	-	-
Lemon Oil	1	-	-	-	-
Limonene	4				4--5
Linalool	10				3

Matricaria Recutita	1				2
mecetronium ethylsulfate	1	-	-	-	-
Methylparaben	1				3--4
n-προπανολη	1	-	-	-	-
Organic aloe	1				1--3
Origanum Dictamnus /Leaf/Stem Extract	1				1
Panthenol	7				1
Parfum	26	-	-	-	-
Patent-blue V (E 131)	1	-	-	-	-
PEG-20 Glyceryl laurate	1				1--3
PEG-40 Hydrogenated castor oil	3				1--3
PEG-60 Aimong Glycerides	1				1--3
PEG-7 Glyceryl Cocoate	1				1--4
Pentylene Glycol	1				1
Phenoxyethanol	2				2--4
Polyquaternium-37	1				1
Polysorbate 20	8				1--3
Potasium iodite	2				2
Potassium Sorbate	2				2
Ppg-26-Buteth-26	1				1--2
Propylene Glycol	8				2--3
Rosmarinus	1				1
Sodium Benzoate	1				1--3
Sodium Cocoamphoacetate	1				1
Sodium lauryl ether sulphate	1				1--3
Sodium hydroxide	1				1--4
Sodium Sulfite	2				1--2
Tetrasodium Edta	3				2
Thymus	1	-	-	-	-
Tocopherol	1				1
Triclosan	1				3--7
Triethanolamine	11				5
Vitamin E	1	-	-	-	-
Wool fat (lanolin)	1				1

None | High

Best | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Worst