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At Least 55 Undeclared Chemical Elements Found in COVID-19 Vaccines from AstraZeneca, CanSino, Moderna, Pfizer, Sinopharm and Sputnik V, with Precise ICP-MS[1]

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Abstract

The experimental vaccines supposedly invented to combat COVID-19 were coercively forced upon the global population beginning late in 2020. They have precipitated innumerable and varied disease conditions ranging from mild to lethal. This increase in health disorders and sudden deaths began to manifest concomitantly with the number of people inoculated and doses administered per person. By the end of 2023, 24 undeclared chemical elements had been detected by Scanning Electron Microscopy Coupled with Energy-Dispersive X-Ray Spectroscopy (SEM-EDX), in the COVID-19 vaccines of the different brands, by various research groups from different countries around the world. In this paper, we report laboratory results from high precision Inductively Coupled Plasma Mass Spectrometry (ICP-MS) that confirm and expand previous results by SEM-EDX. To this end, the contents of vials from different lots of the brands AstraZeneca/Oxford, CanSino Biologics, Pfizer/BioNTech, Sinopharm, Moderna and Sputnik V were analyzed. Among the undeclared chemical elements were detected 11 of the 15 cytotoxic lanthanides used in electronic devices and optogenetics. In addition, among the undeclared elements were all 11 of the heavy metals: chromium was found in 100% of the samples; arsenic 82%; nickel 59%; cobalt and copper 47%; tin 35%; cadmium, lead and manganese in 18%; and mercury in 6%. A total of 55 undeclared chemical elements were found and quantified with

[1] **Editor's Note:** A version of this paper by the same authors has appeared in Spanish on ResearchGate as "Análisis por ICP-MS de "vacunas" contra "COVID-19" de AstraZeneca, CanSino, Moderna, Pfizer, Sinopharm y Sputnik: 55 elementos químicos no declarados. The current version has been edited for format, peer-reviewed, and updated.

ICP-MS. Combining these findings with results from SEM-EDX, altogether 62 undeclared chemical elements have been found in the various products. In all brands, we found boron, calcium, titanium, aluminum, arsenic, nickel, chromium, copper, gallium, strontium, niobium, molybdenum, barium and hafnium. With ICP-MS, we found that the content of the samples is heterogeneous, the elemental composition varies in different aliquots extracted from the same vial.

Keywords: *adverse effects, AstraZeneca, BioNTech, CanSino Biologics, Comirnaty, COVID-19 vaccines, Covishield, ICP-MS, Sinopharm, Covilo, lanthanides, Moderna, nanotechnology, Pfizer, SEM-EDX, Spikevax, Sputnik V, undeclared chemical elements.*

1. Introduction

Shortly after the massive and globally extended vaccination campaign that began in late 2020 and early 2021 — with the aim of preventing symptoms that had formerly always been associated with flu symptoms and that, for reasons still not clarified, were designated as COVID-19 — a large number of people affected by a variety of health disorders around the world began to emerge incrementally. Among them were deaths of millions of people all occurring in parallel with the increasing doses of COVID-19 "vaccines" being injected into the world's population (Beattie, 2021; Servín de la Mora Godinez, 2023a, 2023b; Rancourt, Baudin & Mercier, 2023b). In a recent study on mortality rates in 17 countries in the southern hemisphere, including our own Argentina, taking all age groups in these countries together, an increase in the mortality rate of 0.126 ± 0.004% was found. Such a rise in mortality which would imply that 17.0 ± 0.5 million deaths have in fact occurred due to the injection of more than 13.5 billion doses by September 2, 2023 of the strange new injectables. All of this amounts to a worldwide **iatrogenic event** — the kind caused by clinicians supposedly trying to make things better — that has already killed 0.213 ± 0.006% of the world's population (1 death per every 470 living people) and all of this has occurred in less than 3 years. During that same time the ineffectiveness of the injections has become evident, because they did not prevent any deaths (Rancourt, Baudin, Hickey & Mercier, 2023a). In the meantime, an alarming and growing number of adverse reactions associated with the COVID-19 vaccines, have been recorded in several databases of adverse effects of vaccines around the world. Among them, a flawed but nonetheless indicative system, is the Vaccine Adverse Event Reporting System (VAERS) of the United States (Open VAERS, 2024; for its gross underreporting of injuries, see research by Lazarus et al., 2010).

The different companies and institutes that have been manufacturing and distributing the COVID-19 vaccines claim that their products are based on recombinant DNA technologies, such as synthetic messenger RNA, or viral particles with a specific genetic load, except for Sinopharm, where an inactivated virus is declared (Maldonado, 2022). Curiously, such technologies as those contained in the messenger RNA and recombinant DNA products had never been used in humans, let alone had they ever been applied to the world population. Therefore, when the aggressive inoculation campaigns began, the extent of the toxicity and its effectiveness were unknown, due to its experimental nature. The speed with which they were approved obviously entails a lack of clinical trials and adequate quality controls. Ferguson et al. of the Imperial College London, on March 16, 2020, just five days after the World Health Organization announced the worldwide "pandemic" of SARS-CoV-2, predicted that by August 2020 "in an unmitigated epidemic, we would predict approximately 510.000 deaths in GB [Great Britain] and 2.2 million in the US" and they said further "even if all patients were able to be treated, . . . there would still be in the order of 250,000 deaths in

GB, and 1.1-1.2 million in the US". However, study of the worldwide mortality statistics showed that the disease and death toll for COVID-19 was comparable to prior flu seasons up to the rollout of the COVID-19 vaccines that began in December 2020 (Beattie, 2021; Servín de la Mora Godinez, 2023a, 2023b; Rancourt, Baudin & Mercier, 2023b). After that rollout began, the fear of Seneff & Nigh (2021) that the vaccines would be "Worse than the Disease" was borne out. Just after the rollout, and especially with the boosters, as Beattie, Rancourt, and others would show, death rates greatly increased worldwide and did reach into the millions.

What can possibly be causing the long list of symptoms and clinical morbidities of extreme diversity that have followed the worldwide distribution of the COVID-19 injectable products? The list includes fulminant cancers, autoimmune disorders, bilateral pneumonias, arrhythmias, hepatitis flare ups, kidney failures, aggressive forms of arthritis, thrombosis, thrombocytopenia, heart disease, strokes, paralysis of various sorts, spontaneous abortions, perinatal deaths, infertility reported on a wide scale, neurodegenerative diseases, and many other debilitating and life-threatening conditions (Page et al., 2021; Simpson et al., 2021; McKean & Chircop, 2021; Chantra et al., 2021; Dulcey-Sarmiento et al., 2022; Nyström & Hammarström, 2022; Martínez et al., 2022; Schwab, et al., 2023; Santiago & Oller, 2023; Pérez et al., 2023; Mead, et al., 2024a, 2024b; Hulscher et al., 2024).

Strikingly, the symptoms often involve comorbidities that had never been seen until after the administration of COVID-19 vaccines (personal communication with Youngmi Lee, MD, in Korea; also see her recent papers with Broudy in this journal; Lee & Broudy, 2024a, 2024b). However, in spite of the extreme gravity of the situation world-wide, only halting and piecemeal steps have been taken to address it. Among them, the pharmaceutical company Pfizer, in a trial presided over by Judge Mark T. Pittman in the United States, was forced to declassify documents detailing at least 1.291 adverse events that were formerly undisclosed (GlobalResearch, 2023).

Likewise, in Uruguay, the judiciary demanded that the national government carry out studies "aimed at explaining the notable increase in deaths from [that were attributed to] COVID-19 from March 2021" in contrast to the previous year despite the increase in people inoculated with the vaccines against COVID-19, which theoretically should have reduced the mortality rate (Montevideo — AFP, 2022). Interestingly, AstraZeneca announced in May 2024 its intention to stop marketing its COVID-19 vaccine in Europe. Their product was originally known by the name of the pharmaceutical company itself, "AstraZeneca", as well as the "Oxford vaccine", though its brand name is "Covishield" (La Nación, 2024). In Argentina there are a large number of lawsuits in process (civil and criminal) where adverse events have been reported, not only for AstraZeneca (La voz, 2024) but for all the brands that were administered to the Argentine population (Denuncias Judiciales, 2024).

It is also crucially important to note that, according to studies carried out by the Lazarus working group (Lazarus et al., 2010), adverse effects recorded in the VAERS database of the United States do not represent more than 1% to 10% of total cases, and may represent far fewer than 1%. The underreporting results from many factors: among them is the fact that completing the VAERS forms requires an enormous amount of time on the part of the health personnel in all cases. Another factor is the common absence of knowledge by health clinicians and personnel about the complex dynamics and variety of adverse events produced by prescription drugs in general, and more specifically by the growing number of vaccines pushed upon the public increasingly for a growing diversity of purposes (Garner, 2022; Tuuminen et al. 2023). All of this has been translated into poisoning by prescription drugs and vaccines that have produced a severe deterioration in the health of people impacted by pharmacological products. A dearth of information, maintained by the powerful pharmaceutical lobby that imposes its products on the market, hinders the good judgment of the health professionals who are discouraged from connecting the many emerging symptoms with the vaccines, and with other drugs and harmful medical procedures that are directly or indirectly involved in causing them (McBean, 1957; Duesberg, 1996; Humphries & Roman Bystrianyk, 2013; Mead et al. 2024a, 2024b).

Added to all this is a near total lack of quality control over the substances called "vaccines" by the regulatory authorities of the various countries (Speicher et al. 2023; Gutschi, 2022). Recently, promoters of the mass use of vaccines (Salmon, et al. 2024) had to acknowledge the lack of post-licensure studies to fully characterize the safety profile of a new vaccine. They allege that pre-licensure clinical trials have limited sample sizes, follow-up durations, and too much population heterogeneity. For all these reasons it is imperative to investigate and determine the components in the COVID-19 vaccines. Because of their "experimental" status, even the most basic safety protocols have been dangerously circumvented. This problem has alerted independent scientists around the world because the declared ingredients were known to be toxic and because more and more evidence began to accrue showing that the manufacturers had not declared all of the ingredients in their products. One of the alarming phenomena observed is magnetization (Aristeo et al., 2021, pp. n20, n51, n99) — a phenomenon that is unaccounted for by the declared ingredients.

In early studies on the content of the COVID-19 vaccines some researchers (Campra, 2021; Clayton, 2022) determined the presence of graphene oxide in Pfizer's Comirnaty brand using Micro-Raman and Transmission Electron Microscopy (TEM) techniques. Graphene oxide is an undeclared component and toxic to human cells (Ou et al., 2016) The group known as the "Club 12" reported using Scanning Electron Microscopy coupled with X-ray Scattering (SEM-EDX) showing the presence of carbon, oxygen, fluorine, sodium, magnesium, potassium, calcium, phosphorus, chromium, sulfur, chlorine, bismuth, nitrogen, manganese, cobalt, nickel, selenium, cadmium, antimony, lead, titanium, vanadium, iron, copper, and silicon in Pfizer-BioNtech, Moderna-Lonza, Vaxzevria from AstraZeneca and Janssen from Johnson & Johnson (Aristeo et al., 2021, p. n40). In a first study in Argentina, the "Tango Club", using SEM-EDX applied to samples from vials of AstraZeneca, Moderna, Sinopharm and Sputnik V found the following chemical elements in them: carbon, oxygen, sodium, aluminum, silicon, calcium, magnesium, chlorine, bismuth and technetium (Aristeo et al., 2021, p. n66).

In 2022, Martín Monteverde, MD, and his collaborators (Anabela Femia, biotechnologist; and Lisandro Lafferriere, also a biotechnologist) detected particles with identical morphology to graphene oxide in a total of 49 vials using optical microscopy. The brands analyzed were CanSino, Pfizer, Sinopharm, AstraZeneca, and Sputnik V. In Japan, metallic contaminants were found in vials of the Moderna vaccine (Swift & O'Donnell, 2021) leading to the recall of three lots, corresponding to 1.63 million doses. In addition, in the same batch of Pfizer FF5357, in several vaccination centers in Japan, in the cities of Sagamihara, Kamakura & Sakai, health system workers detected flocs of strange whitish material in the vials and informed the health authorities so that the affected material would not be injected in the population (Kyodo News, 2021), essentially similar to those found by Lee & Broudy (2024a, 2024b).

In 2022, a group of 60 German scientists, including Helena Krenn, Klaus Retzlaff, Holger Reißner and the late pathologist Arne Burkhardt using SEM-EDX, analyzing vials from AstraZeneca, BioNTech/Pfizer, Moderna, Janssen from Johnson & Johnson, Lubecavax, and Influsplit Tetra, detected the following chemical elements: cerium, potassium, calcium, barium, cobalt, iron, chromium, titanium, gadolinium, aluminum, silicon, sulfur, sodium, magnesium, antimony, copper, silver, phosphorus, carbon, oxygen, chlorine, and cesium. These studies were submitted to the government authorities in Germany for review (Retzlaff, 2022).

In England, the UNIT group commissioned by EbMCsquared CIC, within the framework of the UNITC-112980 project, carried out an analysis of AstraZeneca, Moderna and Pfizer vials using the Micro-Raman technique, identifying graphene oxide, calcium carbonate with graphene inclusions, iron oxide, in addition to the known toxicant polyethylene glycol (PEG) which is associated with anaphylaxis (Cabanillias et al., 2021). PEG is declared as part of the cationic phospholipids in Pfizer BNT162b and Moderna-1273 (Segalla, 2023), but not in AstraZeneca. In addition, they reported particles with different morphologies: ribbons, sheets, nanotubes, nano dots and nano scrolls (EBMCsquared CIC, 2022).

In 2022, Daniel Nagase, MD, from Canada carried out SEM-EDX studies on Moderna and Pfizer vials, detecting carbon, oxygen, sodium, magnesium, aluminum, silicon, sulfur, chlorine, potassium, calcium, palladium and thulium (Nagase, 2022; Wilson, 2022). That same year, in Argentina, fluorescent particles of various sizes and with an identical fluorescence pattern to the graphene oxide standard were detected in vials from Pfizer, CanSino, Sinopharm, and AstraZeneca optical microscopy coupled to fluorescence, this study was carried out in the presence of a public notary (Sangorrín & Diblasi, 2022a). Later, foreign particles with different morphology, size, and quantity that exceed the limit specified for particulate matter in the different pharmacopoeias were detected in these same samples by SEM-EDX. The chemical elements carbon, nitrogen, oxygen, fluorine, sodium, magnesium, copper, bromine, titanium, silicon, aluminum, phosphorus, sulfur, chlorine, potassium, calcium, iron, chromium, manganese, and cesium were detected (Sangorrín & Diblasi, 2022b). Geanina Hagimă, MD in obstetrics and gynecology, from Romania studied Moderna and Pfizer vials by SEM-EDX and found carbon, oxygen, magnesium, aluminum, silicon, titanium, yttrium, and tin (Hagimă, 2023a, 2023b).

As a result of the foregoing studies, by the end of 2023, independent researchers from different parts of the world had detected 24 undeclared chemical elements in the formulas of the COVID-19 vaccines. They contained micro and nanoparticles composed mainly of carbon and oxygen. Likewise, many of these findings agreed with previous studies carried out in Italy, where micro and nanoparticles containing the following were detected by SEM-EDX in 44 of the scheduled or programed vaccines: aluminum, silicon, magnesium, titanium, tungsten, chromium, manganese, nickel, iron, calcium, copper, zirconium, gold, silver, cerium, bromine, potassium, zinc, and lead (Gatti & Montanari, 2017). Also in 2021, Martínez, MD, and his collaborators from Argentina carried out studies by SEM-EDX on 5 scheduled or programed vaccines — specifically, Prevenar pneumococcal from Pzifer, Infanrix Hexa from GlaxoSmithKline Biologicals, Viraflu from Sinergium Biotech — and they found: carbon, oxygen, sodium, magnesium, aluminum, silicon, chlorine, potassium, calcium, silver, and bromine. (Aristeo et al., 2021; p. n74).

Based on the 24 chemical elements not declared within the components of the formulas by the pharmaceutical companies and detected by SEM-EDX, the objective of this study was to corroborate, detect possible additional chemical elements and to measure them. For this purpose, 13 vials of the COVID-19 vaccines were analyzed. The vials analyzed in this study come from the following pharmaceutical companies or research institutes: AstraZeneca/Oxford, CanSino Biologics, Pfizer/BioNTech, Sinopharm, Moderna, and the Gamaleya National Research Centre for Epidemiology and Microbiology in Russia.

For the analysis and identification of the constituent elements in the contents of the vials, Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was used. It enables detection, identification, and quantification of metals and metalloids with high sensitivity and precision. With this methodology, almost 95% of the periodic table can be analysed from trace levels to much higher concentrations (ng/L–mg/L). Its main advantage over other methodologies is its high sensitivity (low detection limits) and simultaneity (having the power to detect multiple elements at the same time in a single analysis). Most of the chemical elements of the periodic table can be determined, except: hydrogen, helium, carbon, nitrogen, oxygen, sulfur, fluorine, neon, argon, iodine, bromine, chlorine, astatine, and those with a higher atomic mass than uranium.

2. Materials and Methods

2.1 Samples

Thirteen vials from different lots of the so-called COVID-19 vaccines were analyzed. The brands, batch numbers and expiration dates are shown in Table 1. The samples were analyzed in duplicate.

Table 1
Samples Analyzed by ICP-MS

Manufacturing Laboratory	Brand	Lot	Expiration date
Astrazeneca/Oxford	Covishield	ABZ3413	Nov-21
Astrazeneca/Oxford	Covishield	210581	Mar-22
CanSino Biologics	Convidecia	NCOV202106034V	Jun-21
Centro Gamaleya y RDIF*	Sputnik V	II-840621	Dec-21
Centro Gamaleya y RDIF*	Sputnik V	II-640821	Feb-22
Centro Gamaleya y RDIF*	Sputnik V	LYM8	Dec-22
Moderna	Spikevax	045C22A	Jan-23
Moderna	Spikevax	940915	Jun-22
Pfizer/BioNTech	Comirnaty	SELY6	Nov-22
Pfizer/BioNTech	Comirnaty	FJ1966	Jan-22
Pfizer/BioNTech	Comirnaty	FK8892	Mar-22
Sinopharm	COVILO	202108B2715	Aug-23
Sinopharm	COVILO	202108B2087	Jul-23

*****(RDIF) Russian Direct Investment Fund (2024) paid for just the three marked items.

Table 2 shows the components declared by the different manufacturing laboratories, extracted from the prospectuses requested from INAME-ANMAT (National Drug Institute- National Administration of Drugs, Foods and Medical Technology) in Argentina, through a public information request (Maldonado, 2022). It should be noted that the only brands that declare the

Table 2
Components Declared by the Different Manufacturing Companies

Components Declared by Manufacturers	Products with Modified mRNA to Produce Spike Protein		Products Using Adenovirus Vector to Produce Spike Protein			Inactivated Viruses
	Pfizer/Comirnaty	**Moderna**	**AstraZeneca**	**Sputnik V I/II**	**CanSino Biologics**	**Sinopharm**
Sodium acetate trihydrate		√				
Acetic acid		√				
Recombinant adenovirus			√	√	√	
Water for injections	√	√	√	√	√	
ALC-0159	√					
ALC-0315	√					
Virus antigens						√
Inactivated SARS-CoV-2						
ARNm with modified nucleotides (Elasomeran)		√				
ARNm with modified nucleotides (Tozinameran)	√					
L-histidine hydrochloride monohydrate			√			
Trometamol Hydrochloride		√				
Magnesium chloride				√	√	
Potassium chloride	√					
Sodium chloride	√		√	√	√	√
Cholesterol	√	√				
Potassium dihydrogen phosphate	√					
Sodium dihydrogen phosphate						√
DSPC	√	√				
EDTA			√	√		
Ethanol			√	√		
Disodium hydrogen phosphate	√					√
Glycerin					√	
HEPES					√	
Aluminum hydroxide						√
L-Histidine			√			
Mannitol					√	
PEG 2000-DMG		√				
Polysorbate 80			√	√	√	
Sucrose	√	√	√	√	√	
SM-102		√				
Tris (hydroxymethyl) aminomethane				√		

quantities of the excipients are Sputnik V and Sinopharm (COVILO), unlike Pfizer (Comirnaty), AstraZeneca (Covishield), Moderna,. and CanSino which do not declare the *quantities* of excipients: this is a very serious omission at the regulatory level. The regulations for the pharmaceutical industry worldwide are based on GMP (Good Manufacturing Practices), indicating that it is mandatory to declare all the components of the formulas and the corresponding quantities.

2.2 Drawing of Samples and Digestion

The studies were carried out at ICYTAC (Institute of Food Science and Technology Córdoba — National University of Córdoba — CONICET) by the technical staff in charge of the equipment (Figure 1). Samples were kept refrigerated between 8°C to 11°C from the moment of receipt until

Figure 1. Here is a view of the laboratory, and of the equipment for Inductively Coupled Plasma — Mass Spectrometry (ICP-MS), used in this study.

the day of digestion[2]. Each vial was vortexed with circular motion to ensure homogeneity before drawing samples from any vial. Samples were taken with a 5 μL Hamilton syringe ("Gas tight"), a puncture was made in each rubber septum, extracting a sample volume into a previously tared polypropylene tube, recording the mass of the extracted sample on an analytical balance (between

[2] **Editor's Note:** For readers not used to the technical terminology of laboratory chemical analysis, something not dealt with commonly in this journal, the term "digestion" is correctly translated from the Spanish. In analytical chemistry, digestion of solids, e.g., the "self-assembling" structures observed by Lee and Broudy (Lee & Broudy, 2024a; 2024b), are broken-down into their component chemical elements. Digestion contrasts with dissolution as used by Lee and Broudy to "incubate" samples.

0.22 and 0.33 g). This procedure was done in duplicate for each sample. Blank tubes were also prepared in duplicate, using the same elements and handled in an identical manner to the samples, except for the sample addition, which was replaced by ultra-pure water (between 0.22 and 0.24 g for each instance). For sample digestion, 1 mL of double-distilled nitric acid was added to each tube, and the blanks were treated in the same way. They were homogenized with circular vortex movements and left to rest for 6 days (room temperature 26-29 °C). The digested samples were stored at 10 °C in closed polypropylene tubes until dilution. Prior to the measurement, 9 mL of MERCK brand nitric acid solution, lot K54405956 223 in ultra-pure water 1:50 (v/v) was added to each tube in such a way as to achieve an approximate dilution of 1 to 10. Ultrapure water was used (conductivity 0.055 µS/cm, Sartorius brand equipment, Arium 311 model, with a final filter of 0.22 µm). It should be noted that the presence of the chemical elements, and subsequent identification, is independent of temperature changes, for example, loss of the cold chain.

2.3 Equipment and Measurement by ICP-MS

The ICP-MS equipment, Agilent brand, model: 7500cx, with auto sampling, model ASX-500 Series, was used. The plasma, filler, and other gas used was argon quality 5.0, (>99.999% Air Liquide, Argon N50 type: Alphagaz). For some elements, collision with Helium (quality 5.0, Linde) was used. The software used was Agilent G1834B, ChemStation B.04.00.001. Four types of external calibration curves were prepared, covering all the elements to be quantified, from the commercial mixtures.

2.4 Data Analysis

After acquisition, the calibration curve was adjusted according to the range of counts per second (CPS) presented by the samples. To achieve greater precision, those points of the curve with CPS values greater than the maximum value of the samples, for each element were discarded. The replicas were measured at two temperatures (the standard of 2°C and 30°C) to determine a correction factor on the measured calibration curves. Each reported sample is the result of subtracting the average value of the procedure blank tubes for each element and is corrected by the digestion dilution factor and the weighed mass. In turn, the replicate includes a correction factor for the measured temperature difference. The reported detection limit was calculated as 3.3 times the sample standard deviation of the measured values of the blanks. The limit of quantification used is highlighted by the bold values in the concentration tables and was calculated as 10 times the sample standard deviation of the same blanks. The hypothetical mass of the digestion procedure in the blanks was the mass of water used to simulate each sample.

3. Results

3.1 AstraZeneca (Covishield) Vials

Two lots of the AstraZeneca product were studied. In lot ABZ3413, 15 chemical elements were detected, of which 14 are undeclared, and in lot 210581, 21 elements were detected, with 20 undeclared (Table 3).

Table 3
Chemical Elements Found by ICP-MS in AstraZeneca Lots: † Declared

Chemical Elements		Isotopes	AstraZeneca ABZ3413 (µg/L)	AstraZeneca 210581 (µg/L)
B	Boron	11	20	360
Na†	Sodium	23	1100000	9100000
Mg	Magnesium	24	30000	350000
Al	Aluminum	27	810	
P†	Phosphorus	31		
K	Potassium	39	5100	
Ca	Calcium	40		1800
V	Vanadium	51	2.23	
Cr	Chromium	52	21	44
Fe	Iron	56	82	
Ni	Nickel	58		50
Co	Cobalt	59	0.4	
Cu	Copper	63		34
Ga	Gallium	70	0.1	
As	Arsenic	75	4.4	15
Se	Selenium	79		5.1
Rb	Rubidium	85	1	1.8
Sr	Strontium	88		1.4
Nb	Niobium	93		0.22
Mo	Molybdenum	96		13
Pd	Palladium	106		2
Ba	Barium	137		2.8
Ce	Cerium	140	0.22	
Tb	Terbium	159	0.004	
Hf	Hafnium	178		37
Pt	Platinum	195		2.2
Au	Gold	197		3.9
Tl	Thallium	204		0,69
Bi	Bismuth	209		12
Th	Thorium	232		9.9
U	Uranium	238	0.02	
Total Elements Detected			**15**	**21**
Sample Analysis Date			3/11/2023	27/12/2023

3.2 CanSino Vials (Convidecia)

One lot of the CanSino brand was analyzed and 22 elements were detected. Of those that were detected, 20 were undeclared by the manufacturer (Table 4).

Table 4
Chemical Elements Found by ICP-MS in a lot of CanSino (Convidecia) NCOV202106034V: † Declared

Chemical Elements		Isotopes	CanSino (µg/L)
B	Boron	11	20
Na†	Sodium	23	800
Mg †	Magnesium	24	13000000
Al	Aluminum	27	870000
P†	Phosphorus	31	
K	Potassium	39	1900
Ca	Calcium	40	150
V	Vanadium	51	38
Cr	Chromium	52	21
Fe	Iron	56	37
Ni	Nickel	58	0.1
Co	Cobalt	59	28
Cu	Copper	63	68
Ga	Gallium	70	0.54
As	Arsenic	75	920
Se	Selenium	79	6
Rb	Rubidium	85	5
Sr	Strontium	88	1,3
Nb	Niobium	93	14
Mo	Molybdenum	96	11
Pd	Palladium	106	120
Ce	Cerium	140	0.2
Tb	Terbium	159	2.5
Total Elements Detected			**22**
Sample Analysis Date			27/12/2023

3.3 Pfizer (Comirnaty) Vials

Vials from three lots of the Pfizer brand were analyzed. In lot FJ1966, 22 elements were detected, of which 19 are undeclared (Table 5), in lot FK8892, 19 elements were detected, of which 16 are undeclared. Lot SELY6 was analyzed on two dates, in November 2023, 23 chemical elements were detected, of which 21 elements are undeclared, in January 2024, 26 chemical elements were detected, of which 23 elements are undeclared.

Table 5
Chemical Elements Found by ICP-MS in Pfizer (Comirnaty) Lots: † Declared

Chemical Elements		Isotopes	Pfizer/BioNTech FJ1966 (µg/L)	Pfizer/BioNTech FK8892 (µg/L)	Pfizer/BioNTech SELY6 (µg/L)	Pfizer/BioNTech SELY6 (µg/L)
Li	Lithium	7			62,00	17
B	Boron	11	1400	170	2200	860
Na	Sodium	23	27000000	58000000	4900000	4700000
Mg	Magnesium	24	54000			
Al	Aluminum	27		230000	61	34000
P†	Phosphorus	31	940000	6700000		390000
K†	Potassium	39	7000000	64000000	110000	66000
Ti	Titanium	48	1000	6200		
V	Vanadium	51			9.2	21
Cr	Chromium	52	56	57	30	72
Mn	Manganese	55		19		
Ni	Nickel	58	27	18		4.8
Co	Cobalt	59			0.87	1.7
Cu	Copper	63	90	71		
Zn	Zinc	65	540			2700
Ga	Gallium	71	0.55	2.2	0.35	0.72
As	Arsenic	75	18	22	27	13
Se	Selenium	78		7.5		
Rb	Rubidium	85	1.1	1.9	1.5	
Sr	Strontium	87	2.3	1.4		12
Nb	Niobium	93	0,6	0,8		
Mo	Molybdenu	96	12			
Ru	Ruthenium	101	0.001		0.001	
Rh	Rhodium	103				0.04
Pd	Palladium	105	0.51	0.8	0.1	0.25
Ba	Barium	137	64	3.3	69	33
La	Lanthanum	139			0.56	0.35
Ce	Cerium	140	1.4		5.1	2.4
Pr	Praseodymiu	141	0.14			
Sm	Samarium	150				0.025
Eu	Europium	153			0.02	0.025
Tb	Terbium	159			0.0002	
Gb	Gadolinium	157				0.02
Dy	Dysprosium	162				0.014
Er	Erbium	167			0.06	0.005
Hf	Hafnium	178	3.1	2		
W	Wolfram	183	4.8			
Pt	Platinum	195			0.42	
Pb	Lead	208			45	
U	Uranium	238			0.25	
Total Elements Detected			**22**	**19**	**23**	**26**
Sample Analysis Date			27/12/2023	27/12/2023	3/11/2023	3/1/2024

3.4 Moderna (Spikevax) Vials

Two lots of the Moderna brand were analyzed. In lot 940915, 23 elements were detected of which 21 elements are undeclared; in lot 045C22A, 17 elements were detected, 16 undeclared (Table 6). This last lot was quantified again in January 2024, 31 elements were detected, 29 of them undeclared.

Table 6
Chemical Elements Found by ICP-MS in Moderna Lots: † Declared

Chemical Elements		**Isotopes**	**Moderna 940915 (µg/L)**	**Moderna 045C22A (µg/L)**	**Moderna 045C22A (µg/L)**
B	Boron	11	320		
Na†	Sodium	23	47000000	1300000	180000
Mg	Magnesium	24		170	13000
Al	Aluminum	27			17000
P†	Phosphorus	31	430000		400000
K	Potassium	39	39000000		36000
Ca	Calcium	40			4500
Ti	Titanium	48	9500		
V	Vanadium	51		1.7	5.2
Cr	Chromium	52	58	23	46
Mn	Manganese	55	3.6		15
Fe	Iron	56		270	2400
Ni	Nickel	58	15		20
Co	Cobalt	59		0.18	2.6
Cu	Copper	63	44		
Zn	Zinc	65			4600
Ga	Gallium	70	1.4	0.11	0.47
As	Arsenic	75	20	1.31	
Se	Selenium	79	3.3		
Rb	Rubidium	85	1		2.9
Sr	Strontium	87	0.3	5.1	17
Y	Yttrium	89			0.22
Zr	Zirconium	91	550		
Nb	Niobium	93	2.2		
Mo	Molybdenum	96	390		
Ru	Ruthenium	100			0.0007
Pd	Palladium	106	2.8		
Ag	Silver	107	5.1		
Cd	Cadmium	112			3.2
Sn	Tin	118	37	17	
Sb	Antimony	121			1.1
Ba	Barium	137	11		
La	Lanthanum	139		0.38	0.18
Ce	Cerium	140		0,.7	0.27
Pr	Praseodymium	141			0.025
Nd	Neodymium	144			14
Tb	Terbium	159		0.011	
Dy	Dysprosium	162		0.019	0.0051
Ho	Holmium	165		0.005	
Yb	Ytterbium	173		0.008	
Hf	Hafnium	178	15		3.3
W	Tungsten	183			11
Au	Gold	197			1.8
Hg	Mercury	200			13
Tl	Thallium	204			0.28
Pb	Lead	207			130
Th	Thorium	232	0.82		
U	Uranium	238		0.023	
Total Elements Detected			**23**	**17**	**31**
Sample Analysis Date			27/12/2023	3/11/2023	3/1/2024

3.6 Sinopharm (COVILO) Vials

Different elements were detected in the two lots analyzed from Sinopharm: 202108B2087 and 202108B2715 COVILO, 25 elements were detected, 22 and 23, respectively, are undeclared elements. The determination of lot 202108B2715 was repeated in January 2024, on this date 17 undeclared elements were found out of the 20 that were detected (Table 7).

Table 7
Chemical Elements Found by ICP-MS in Sinopharm (COVILO) Lots: † Declared

Chemical Elements		Isotopes	Sinopharm 202108B2087 (µg/L)	Sinopharm 202108B2715 (µg/L)	Sinopharm 202108B2715 (µg/L)
Li	Lithium	7	42	13	
B	Boron	11	2500	2000	690
Na†	Sodium	23	39000000	5000000	4200000
Mg	Magnesium	24			38000
Al†	Aluminum	27	3100000	205000	2700000
P†	Phosphorus	31	3000000		2000000
Ca	Calcium	40	1700		2800
Ti	Titanium	48	3200		
V	Vanadium	51	17	8.15	17
Cr	Chromium	52	76	28.5	61
Fe	Iron	56		31	
Ni	Nickel	58	20		
Co	Cobalt	59		0.43	0.16
Cu	Copper	63	100		
Ga	Gallium	70	5.5	6.25	7.7
As	Arsenic	75	9.6	6.65	
Se	Selenium	79			4.8
Sr	Strontium	87	36		2.8
Y	Yttrium	89		15	0.21
Nb	Niobium	93	0.5		
Mo	Molybdenum	96	2.8		
Ru	Ruthenium	101		0.001	
Pd	Palladium	106	0.4	0.03	
Sn	Tin	118		85	
Sb	Antimony	121	3.2		
Te	Tellurium	127		0.4	
Ba	Barium	137	360	16,5	
La	Lanthanum	139	3.5		0.055
Ce	Cerium	140	21	1.2	0.68
Pr	Praseodymiu	141			0.018
Nd	Neodymium	144			0.16
Sm	Samarium	150			0.044
Eu	Europium	152		0.02	
Gd	Gadolinium	157			0.023
Tb	Terbium	159		0.006	
Dy	Dysprosium	162		0.026	
Ho	Holmium	165		0.0056	
Er	Erbium	167	0.47	0.03	0.0028
Yb	Ytterbium	173		0.012	
Hf	Hafnium	178	2.4		
W	Tungsten	183	19		
Pt	Platinum	195		0.29	
Au	Gold	197	0.7		
Total Elements Detected			**25**	**25**	**20**
Sample Analysis Date			27/12/2023	3/11/2023	3/1/2024

3.7 Vials from Gamaleya Center and RDIF, Russia (Sputnik)

Of the three Sputnik lots analyzed, lot LYM8 contained 21 elements, of which 19 are undeclared (Table 8). Lot II-840621 was analyzed on two dates and contained a total of 22 and 27 elements, 20 and 25 respectively are undeclared. Finally, lot II-640821 contained 27 elements, with 24 undeclared (Table 8).

Table 8
Chemical Elements Found by ICP-MS in Sputnik Lots: † Declared

Chemical Elements		Isotopes	Sputnik LYM8 (μg/L)	Sputnik II-840621 (μg/L)	Sputnik II-840621 (μg/L)	Sputnik II-640821 (μg/L)
Li	Lithium	7		12		
B	Boron	11	1000	2500	700	1300
Na†	Sodium	23	58000000	4300000	3000000	48000000
Mg†	Magnesium	24	280000	27000	50000	310000
Al	Aluminum	27		200	2600	
P†	Phosphorus	31				33000
K	Potassium	39		9500	7200	
Ca	Calcium	40	2000			5000
Ti	Titanium	48				56
V	Vanadium	51	26	9.60	17	16
Cr	Chromium	52	110	38	63	95
Ni	Nickel	58	33			51
Co	Cobalt	59			0.37	
Cu	Copper	63	160			170
Zn	Zinc	65	150			140
Ga	Gallium	70	0.2	0.36		0.33
As	Arsenic	75	13	9.6		9.2
Se	Selenium	79				4.1
Rb	Rubidium	85	2.4	2.5		3.2
Sr	Strontium	88	8.1	4.1		4.5
Nb	Niobium	93	1.2			0.2
Mo	Molybdenu	96				2.8
Ru	Ruthenium	101			0.017	
Pd	Palladium	106	7.6	0.06		0.7
Cd	Cadmium	112		10	2.3	
Sn	Tin	118		88		8.8
Ba	Barium	137	920	18		21
Ce	Cerium	140	31	62	22	30
Nd	Neodymium	144			0.051	
Gd	Gadolinium	157	0.3	0.27	0.23	0.3
Tb	Terbium	159		0.006		
Ho	Holmium	165		0.0054		
Yb	Ytterbium	173		0.006		
Hf	Hafnium	178	3.9			5
Au	Gold	197	1.1		0.43	2
Tl	Thallium	204				0.3
Pb	Lead	207		24		
Th	Thorium	232	0.6			1.1
Total Detected			**21**	**22**	**27**	**27**
Analysis Date			27/12/2023	3/11/2023	3/1/2024	27/12/2023

4. Discussion

4.1 Elemental composition of COVID-19 Vaccines

Our analysis summarized in Tables 9 and 10 shows the presence of 55 undeclared chemical elements in the 17 samples analyzed from the 6 brands of COVID-19 vaccines. Among the undeclared elements were found to represent all groups of the Periodic Table, except for the noble gases.

Many heavy metals was detected in the analyzed samples and all of those metals are associated with toxic effects on human health. The European Union recognizes eleven toxic elements as heavy metals; arsenic, cadmium, cobalt, chromium, copper, mercury, manganese, nickel, lead, tin, and thallium (Witkowska et al., 2021; Hogan, 2010). All these elements were found in the different lots with different frequencies of occurrence in the sampling: chromium (100%), arsenic (82%) and nickel (59%), followed by 40% cobalt and copper; with 35% tin, with 18% cadmium, lead and manganese; and finally 6% of the samples contain mercury (Table 9).

The samples contain 11 of the 15 lanthanides of the periodic table of chemical elements. The percentage of the frequency with which they were found is shown in Table 9: lanthanum (35%), cerium (76%), neodymium (18%), samarium (18%), europium (18%), gadolinium (35%), terbium (29%), dysprosium (24%), holmium (18%), erbium (29%), and ytterbium (18%). These elements have luminescent and magnetic properties (Echeverry & Parra, 2019); until now, their safety for use in the human body has not been demonstrated. In fact, the ICH Q3D guide (ICH, 2022) does not mention lanthanides among elemental impurities. It should be noted that this guide does not cover biological products, such as vaccines. Lanthanides are frequently used in the electronics industry and in no case as part of biosensors due to their cytotoxic effects (Voncken, 2016; Balaram, 2018).

To date, if the results obtained by both SEM-EDX (Aristeo et al., 2021, pp. n40, n66; Retzlaff, 2022; Nagase, 2022; Sangorrín & Diblasi, 2022b; Hagimă, 2023a, 2023b) and ICP-MS are taken into account for the brands studied here, a total of 62 undeclared chemical elements have been detected (Table 10).

The two techniques are complementary, and they also have their limitations and differences. In SEM-EDX the sample volume varies between 10-20 μL, only the particles found in that small volume can be observed, while by ICP-MS a sample volume of 200 μL is taken and is more representative. In turn, SEM-EDX can detect carbon, nitrogen, oxygen, silicon, fluorine, chlorine, bromine, and sulfur (which could not be determined by ICP-MS), and which are present in the samples, only carbon, nitrogen, and oxygen are declared in the manufacturers formulas (Table 2). Hydrogen cannot be detected by either technique.

In the ICP-MS technique, the sample is digested with HNO_3, leaving the chemical elements free in the solution, while by SEM-EDX, chemical elements are detected within the micro and nanoparticles found in the sample. One of the advantages of the ICP-MS technique is that chemical elements can be quantified.

In reading across rows three and six in Table 10, we can see that the brands most frequently analyzed by both SEM-EDX and ICP-MS were Pfizer, Moderna, and AstraZeneca. The greatest number of undeclared chemical elements were detected in these brands. By contrast, the fewest undeclared elements were found in the Sputnik V and the CanSino brands but, it must be taken into consideration, that from these two brands, we only drew one sample from each of the vials, so the absolute minimum number of analyses were performed. Obviously, whether more or fewer

Table 9
Frequency of Elements in the Analyzed Samples and Maximum Concentration

	Chemical Elements		Isotopes	Samples with	% Samples with	Max Concentration (µg/L)
1	Sodium	Na	23	17	**100**	**58000000**
2	Chromium	Cr	52	17	**100**	**110**
3	Boron	B	11	15	**88**	**2500**
4	Gallium	Ga	70	15	**88**	**7.7**
5	Arsenic	As	75	14	**82**	**920**
6	Strontium	Sr	87	13	**76**	**36**
7	Cerium	Ce	140	13	**76**	**110**
8	Vanadium	V	51	12	**71**	**38**
9	Palladium	Pd	106	12	**71**	**120**
10	Barium	Ba	137	12	**71**	**360**
11	Magnesium	Mg	24	11	**65**	**13000000**
12	Rubidium	Rb	85	11	**65**	**5**
13	Aluminum	Al	27	10	**59**	**3100000**
14	Nickel	Ni	58	10	**59**	**51**
15	Potassium	K	39	9	**53**	**64000000**
16	Hafnium	Hf	178	9	**53**	**37**
17	Phosphorus	P	31	8	**47**	**6700000**
18	Calcium	Ca	40	8	**47**	**5000**
19	Cobalt	Co	59	8	**47**	**28**
20	Copper	Cu	63	8	**47**	**170**
21	Niobium	Nb	93	8	**47**	**14**
22	Gold	Au	197	7	**41**	**3.9**
23	Gadolinium	Gd	157	6	**35**	**0.3**
24	Tin	Sn	118	6	**35**	**88**
25	Lithium	Li	3	6	**35**	**62**
26	Titanium	Ti	48	6	**35**	**9500**
27	Selenium	Se	79	6	**35**	**6**
28	Molybdenum	Mo	96	6	**35**	**390**
29	Lanthanum	La	139	6	**35**	**3.5**
30	Terbium	Tb	159	5	**29**	**2.5**
31	Erbium	Er	167	5	**29**	**0.47**
32	Zinc	Zn	65	5	**29**	**4600**
33	Thorium	Th	232	5	**29**	**9.9**
34	Ruthenium	Ru	100	4	**24**	**0.007**
35	Thallium	Tl	204	4	**24**	**0.69**
36	Uranium	U	238	4	**24**	**0.25**
37	Iron	Fe	56	4	**24**	**2400**
38	Dysprosium	Dy	162	4	**24**	**0,019**
39	Ytterbium	Yb	173	3	**18**	**0,012**
40	Manganese	Mn	55	3	**18**	**19**
41	Cadmium	Cd	112	3	**18**	**10**
42	Antimony	Sb	121	3	**18**	**3.2**
43	Praseodymium	Pr	141	3	**18**	**0.14**
44	Europium	Eu	152	3	**18**	**0.02**
45	Holmium	Ho	165	3	**18**	**0.0056**
46	Platinum	Pt	195	3	**18**	**2.2**
47	Lead	Pb	207	3	**18**	**130**
48	Neodymium	Nd	144	3	**18**	**14**
49	Samarium	Sm	150	3	**18**	**0.044**
50	Yttrium	Y	89	3	**18**	**15**
51	Tungsten	W	183	3	**18**	**19**
52	Rhodium	Rh	103	1	**6**	**0.04**
53	Zirconium	Zr	91	1	**6**	**550**
54	Silver	Ag	107	1	**6**	**5.1**
55	Tellurium	Te	127	1	**6**	**0.4**
56	Mercury	Hg	200	1	**6**	**13**
57	Bismuth	Bi	209	1	**6**	**12**

Table 10
Chemical Elements Detected by SEM-EDX and ICP-MS

Manufacturers	CanSino Biologics	AstraZeneca	Pfizer Comirnaty	Moderna	Sinopharm	Sputnik V/I	Sputnik V/II
Elements Declared by Manufacturer	C, H, O, N, Cl, Na, Mg, P	C, H, O, N, P, Cl, Na	C, H, O, N, P, Cl, Na, K	C, H, O, N, P, Cl, Na	C, H, O, N, P, Cl, Na, Al	C, H, O, N, P, Cl, Na, Mg	C, H, O, N, P, Cl, Na, Mg
Number of Samples Analyzed by ICP-MS	**1**	**2**	**4**	**3**	**3**	**1**	**3**
Chemical Elements Detected by ICP-MS	Li, B, Na, Mg, Al, Ca, Ti, Cr, Ni, Cu, Ga, As, Se, Rb, Sr, Nb, Mo, Pd, Ba, Hf, Au, Tl, Th	B, Na, Mg, Al, K, Ca, V, Cr, Fe, Co, Ni, Cu, Ga, As, Se, Rb, Sr, Nb, Mo, Pd, Ba, Ce, Tb, Hf, Pt, Au, Tl, Bi, Th, U	Li, B, Na, Mg, Al, P, K, Ca, Ti, V, Cr, Mn, Co, Cu, Ni, Zn, Ga, As, Se, Rb, Sr, Nb, Mo, Ru, Rh, Pd, Sn, Sb, Ba, La, Ce, Pr, Sm, Eu, Gd, Tb, Dy, Er, Hf, W, Pt, Pb, U	B, Na, Mg, Al, P, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Ru, Pd, Ag, Cd, Sn, Sb, Ba, La, Ce, Pr, Nd, Tb, Dy, Ho, Yb, Hf, W, Au, Hg, Tl, Pb, Th, U	Li, B, Na, Mg, Al, P, Ca, Ti, V, Cr, Fe, Co, Ni, Cu, Ga, As, Se, Sr, Y, Nb, Mo, Ru, Pd, Sn, Sb, Te, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb, Hf, W, Pt, Au, U	B, Na, Mg, Ca, V, Cr, Ni, Cu, Zn, Ga, As, Rb, Sr, Nb, Pd, Ba, Ce, Gd, Hf, Au, Th	Li, B, Na, Mg, Al, P, K, Ca, Ti, V, Cr, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Nb, Mo, Ru, Pd, Cd, Sn, Ba, Ce, Nd, Gd, Tb, Ho, Yb, Hf, Pt, Au, Tl, Pb, Th
Total Elements Not Declared but Detected by ICP-MS	**21**	**29**	**40**	**46**	**41**	**19**	**36**
Number of Samples Analyzed by SEM-EDX	**1**	**4**	**5**	**5**	**2**	**1**	**0**
Chemical Elements Detected by SEM-EDX	C, O, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Fe, Cu, Br	C, N, O, F, Na, Al, Si, S, Cl, Ca, Ti, Cr, Fe, Co, Ni, Cu, Tc, Ag, Sn, Ce, Gd	C, N, O, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Cu, Y, Tm, Bi	C, N, O, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Fe, Cu, Se, Pd, Cd, Sn, Sb, Cs, Ba, Ce, Pb, Bi	C, O, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Cu	C, O, Na, Cl	Not available
Total Not Declared but Detected by SEM-EDX	**10**	**17**	**15**	**20**	**7**	**0**	Not available
Total Not Declared but Found by Both ICP-MS and SEM-EDX	**27**	**37**	**47**	**51**	**45**	**19**	**36**

elements appear depends in part on the number of analyses that could be carried out. It does not depend completely on the brand being sampled. In addition, it is evident that despite having different declared chemical contents, there are undeclared chemical elements in common, such as boron, calcium, titanium, aluminum, arsenic, nickel, chromium, copper, gallium, strontium, niobium, molybdenum, barium, and hafnium in all of the brands.

4.2 Structure of the Contents of COVID-19 Vaccines

Sodium and chromium were found in all the samples (100%, Table 9). There were many other undeclared elements were in the majority, such as boron and gallium (88%), vanadium, cerium, platinum, and barium (71-76%) like many others listed in Table 9. Given the diversity and notable presence in all brands, along with the peculiar characteristics of the elements found, it is extremely unlikely, in our judgment, that the findings reported in this paper are due to any fortuitous events such as contamination, or accidental adulteration. We do not believe that accidents owed to chance could occur so consistently and pervasively across the various brands of vaccines that we studied. Whereas the appearance of the daunting diversity of undeclared chemical elements remains strange, the clues seem to be pointing to some kind of worldwide technological experimentation. Because the lanthanides, as we have noted above, are known to be extremely cytotoxic (Voncken, 2016; Balaram, 2019), their being discovered in significant quantity, and across the whole array of vaccines we have studies here, is suggestive of some kind of nanotechnological experimentation along the lines being discussed by Kyrie & Broudy (2022), Lee and Broudy (2024a), Hughes (2024), and others.

All the samples had a certain viscosity and density. None of the content was aqueous, it was viscous and dense, probably, we believe, as a consequence of some quantity of water associated with the samples, as noted during several weeks of incubation. That wetting was probably produced by gelling agents, because they have a high affinity for water. Given all the noted characteristics of the fluids in the vials that were analyzed, their content seems to be changing across time. The contents of all the vials were heterogeneous in unexpected ways. In spite of their seemingly common viscous matrix, even with repeated draws from the same vial, we never found homogeneous content in different samples even when they were drawn from the same vial. This occurred in spite of the fact that before drawing any sample from any of the vials, each vial was always subjected to vortex mixing to ensure homogeneity as much as possible. Also, we supposed that if the original contents in any vial were uniform and homogeneous, the distribution of components would be unaffected by vigorous mixing.

It is common knowledge that well mixed homogeneous solutions always have a certain distribution of the solutes that comprise them, even if the solutes are found in very low concentrations. If that were the case for the vials we examined, all the constituent elements should be present consistently, in each and every sample of solution from a particular vial. They should, in fact, appear in the same proportion and in the same relative quantities. But that is not what we found. Because of the complex, dynamic, and changing contents in all of the brands studied in this work, consistent with the findings of Lee and Broudy (2024a), the observed heterogeneity makes it impossible to quantify the elements precisely, or to extrapolate from any given sample to what is contained in the residual fluid in any given vial. It seems that the presence and relative quantities of the elements found in samples taken at different times vary across phases of self-assembly cycles as observed, for instance, in the careful research of Lee & Broudy. Notably it was praised for its consistency and reliability even by its highly competent critic (Ulrich, 2024).

There is, however, as far as we know, no way to determine the number or duration of growth phases beginning at the nano level in the contents of the vaccines under study as the construction phases progress to the visible microstructures seen in incubated samples and in the blood of recipients of the injectables (Lee et al., 2022; Benzi-Cipelli et al., 2022). It seems likely that the elements in the samples with different distributions are associated in discrete units of the self-assembling microstructures visible under optical microscopes. Apart from such generally known chemical properties as luminescence, electromagnetism, toxicity, etc., our findings cannot provide much useful information about the roles that the widely observed self-assembling microstructures may play. A high priority is to determine the identities, functions, and implications of those structures. What is not in doubt is that they are empirically associated with numerous and extreme adverse reactions, including millions of deaths, evidently caused by the administration of the inoculum under study here.

The variable of temperature is of particular interest, because any crucial genetic material intentionally placed in the vials would be well-preserved at temperatures close to 20°C below zero. So, we wonder why Pfizer initially urged a cold chain of custody at no warmer than 80°C below zero. Of course, subjecting genetic material encapsulated in lipid nanoparticles to freeze-thaw cycles causes their denaturation and drastically reduces the capacity of the genetic material to enter the cells as intended (Segalla, 2024). Therefore, some cold chain of custody seems warranted, but unless the purpose was to prevent the formation of complex self-assembling microstructures inside the vials before their contents could possibly be injected into human recipients, the initial setting at 80°C below zero is anomalous.

4.3 Undeclared Nanotechnology Found in COVID-19 Vaccines

In addition to the analysis of the composition, researchers from different parts of the world have been carrying out studies on samples of COVID-19 vaccines and observing the phenomenon of self-assembly of nano and microparticles of orthogonal morphology (Delgado, 2022; Nixon, 2023; Lee & Broudy, 2024a; Zelada, 2024).

The growing presence of nanotechnology-based products in almost all spheres of science, especially in pharmaceutical products, raises concerns regarding their quality, safety, efficacy and toxicity (Mahamuni-Badiger & Dhanavade, 2023). Most of the available nanomedicines work by interacting at the biomolecular level with cellular components and genetic material, directly and indirectly influencing genomic functions (Ali et al., 2023). Of special interest in the present study is the emergent concept of "nanoarchitecture", in which self-assembly processes involve a wide range of materials and applications (Devaraj et al., 2021). These include transmembrane channels, peptide conjugates and vesicles, drug delivery, cell culture, supramolecular differentiation, molecular recognition, optics, and energy storage (Ariga et al., 2019). To develop these materials, in many cases, graphene oxide is used, functionalized with chemical elements such as palladium, nickel, tin, gold, cobalt, and copper (Hejazi et al., 2021), which are present in more than 40% of the vaccine samples analyzed in this work (Table 9). Likewise, other undeclared chemical elements known to be used for self-assembling materials (Hejazi et al., 2021) were found in percentages of the samples ranging from 18% to 35%: selenium (35%), titanium (35%), zinc (29%), cadmium (18%), manganese (18%) and platinum (18%).

Given the wide variety of nanomaterials, colloidal quantum dots that provide unique optoelectronic features for neural interfaces (Hu et al., 2024) aiming for neuronal control (Karatum et al., 2022), we find it especially interesting that researchers such as Hu and colleagues have been busy evaluating the toxicity of different types of quantum dots (CdSe, CdTe, MoS_2, graphene QDs, etc.) at different doses (10-100 ppm, 1-25 nM, etc.) in different cell cultures (BV2, U87, U373, U251, etc.). In recent years, up-conversion nanoparticles have been developed. These are nanocrystals doped with lanthanide ions (Dy^{3+}, Er^{3+}, Eu^{3+}, Gd^{3+}, Ho^{3+}, Lu^{3+}, Sm^{3+}, Tb^{3+}, Tm^{3+}, Y^{3+}, Yb^{3+}), which are excitable by infrared light and are used in optogenetics to activate or deactivate light-sensitive membrane proteins present in neurons, such as opsins and rhodopsins, corresponding to a neuromodulation mechanism (Chen et al., 2016; Yi et al., 2021). Up-conversion nanoparticles of $NaGdF_4$, $NaYF_4$, $NaErF_4$ doped with lanthanides, were tested in different neuron populations for optogenetic modulation (Liu et al., 2021). It was determined that NaYF UCNPs doped with Yb^{3+}, Er^{3+}, Tm^{3+} and Ho^{3+} can be taken up by neurons through clathrin- and caveolae-mediated endocytosis (Zajdel et al., 2023).

5. Conclusions

Based on the identification and ranges of the quantities of the chemical elements discovered, and on the physical and chemical characteristics of the content of the vaccines studied, it is of utmost importance to highlight the great similarity that exists between the products of the different brands. The observed differences in chemical elements found in the different brands, we believe, are due to the time lapse between drawing of samples on account of the changing structure of the self-assembling entities in the fluids contained in the vials. We do not believe the observed differences are because of manufacturing processes specific to any given brand or to differences between lots because of stochastic variations in the production processes. Despite the small size and few samples analyzed in this exploratory study, we believe that analysis of a larger number of samples and lots will confirm the trends we have pointed out. We believe that the various and diverse pathologies in the inoculated population are not due to fortuitous problems in manufacturing or distribution, but rather to the technology that seems to be common to all these products which appear to be universally harmful to humans.

Author Contributions

Marcela Sangorrín and Lorena Diblasi designed the study. All authors analyzed the data. David Nonis established the statistical model of frequency distribution. Martín Monteverde, Marcela Sangorrín and Lorena Diblasi were responsible for sample submission. All authors contributed to the writing and editing of the manuscript.

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