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Index

„CHEMISTRY ought to be

not for chemists alone.”

Miguel de Unamuno (Spanish philosopher, poet, playwright)

[https://www.azquotes.com/quote/826538?ref=chemistry]

Flower paintet by students participating at UBSU 2018 using chemical reagents

Foto: Traian Păsătoiu

BIO VERSUS NON-BIO FOOD ENERGY

Living organisms (animals and humans) need a minimum amount of energy to survive. This energy is necessary in their metabolism for maintaining the cellular functions, heating, drive their muscles etc. Organic substances are the principal source for the energy of living world. All organisms, bacteria, plants, animals, humans included, generate energy from organic compounds in the same way, through the process of cellular respiration. The chemical energy produced by respiration, derived from alimentation is called **food energy**. The release of energy is produced inside the cells during the redox processes catalyzed by enzymes.

Cellular respiration involves chemical reactions between food molecules and oxygen in the aerobic respiration process, or there may be processes of reorganizing molecules in the absence of oxygen in anaerobic respiration [1].

The main components of the food are

- glucides (sugars or carbohydrates), fats (lipids), proteins in high percentage (90% of dry food), representing almost all food quantity;
- vitamins and minerals, fibers, water, cholesterol represent a small weight percentage [2];
- organic acids, polyols (polyhydroxy compounds) and ethanol in very small quantities.

Some components from food (water, vitamins, minerals, cholesterol) do not undergo chemical changes after the respiration process, they are used by the body in the form in which they were absorbed, so they do not provide energy, but they are needed for other reasons.

Using the International System of Units, one can measure energy in joules (J) or in its multiples, 10^3 J, the kilojoule (kJ), most often used for food-related quantities. An older metric system unit for energy, still widely used in food-related contexts, is the calorie, or kilocalorie (kcal or cal). The correspondence between the two energy units is: 1 cal = 4.184 J.

The amount of energy per gram of food (energy density or calorific power) is given, for some components, in Table 1.

Table 1. Energy density for main components from food

Food component	***Energy density***	
	kJ/g	kcal/g
Fats	37	8.84
Proteins	17	4.06
Carbohydrates	17	4.06
Ethanol	29	6.93
Organic acids	13	3.11
Polyols (sugar alcohols, sweeteners)	10	2.39
Fibers	8	1.91

One can observe from Table 1 that fats and ethanol have the largest amount of food energy per gram, 37 and 29 kJ/g, or 8.84 and 6.93 kcal/g, respectively, most carbohydrates and proteins have about 17 kJ/g, respectively 4.06 kcal/g. The combustion heats for glucose, sucrose and starch are 15.57, 16.48 and 17.48 kJ/g, or 3.72, 3.94 and 4.18 kcal/g respectively. Fibers have the smallest contribution to energy in food [3]. The differences between energy density of food (fat, alcohols, carbohydrates and proteins) are due to their varying proportions of carbon, hydrogen, and oxygen atoms.

Only simple ingredients such as glucose, fructose (from sugars, nuts, sweets), amino acids (from meat and vegetable proteins), and vitamins, minerals and antioxidants are assimilated by the organism without further processing. Some of the basic components are deposited in the body or suffer decompositions in simpler molecules. Carbohydrates, fats, and proteins active acetate molecules, being involved in a cyclic process called the *tricarboxylic acid cycle*. At the end of the biochemical decomposition of food (multiple macromolecule breakdowns, redox processes, etc.), water, carbon dioxide and a significant amount of ***energy*** is formed [4].

Many governments require food manufacturers to label the energy content of their products, to help consumers control their energy intake. In the European Union, manufacturers of packed food must label the nutritional energy of their products in both kilocalories and kilojoules, when required, being accompanied by mandatory particulars and additional information, in accordance with European provisions in Regulation No 1169/2011 on consumer information on foodstuffs.

These are:

- The name of the product;
- List of ingredients;
- Substances causing allergies or intolerance (such as milk, mustard, gluten-containing cereals, eggs, fish, peanuts, etc.);
- Quantity of certain ingredients or categories of ingredients;
- Net quantity of food;
- Minimum durability or consumption cate;
- Special storage conditions and / or conditions of use;
- Name or business name and address of the operator or importer;
- Country of origin or place of provenance for certain types of meat or where omission of this type of information could mislead the buyer;
- Instructions for use if their omission would make proper use of the food difficult;
- For beverages containing more than 1.2% by volume of alcohol, the alcoholic strength gained;
- A nutrition declaration.

Worldwide programs and organizations define the term BIO/organic/ecological as follows: "Bio products/organic products are produced through bio/organic/ ecological agriculture by farmers who use natural resources and preservatives from nature to provide product quality for generations to come". Before being named and labeled as organic, a product must be certified by European certification organizations accredited worldwide to guarantee standards. Bio organic products are 100% natural products (unlike those called "natural" that we find in trade and which actually contain many chemical ingredients along with a natural one), contain no chemical compound, and the ingredients from their composition were organically grown (without fertilizers, pesticides, etc.) and extracted by natural methods.

References

1. *K. Schmidt-Rohr, Why Combustions Are Always Exothermic, Yielding About 418 kJ per Mole of O_2. J. Chem. Educ. 92, 2094–2099, 2015.*
2. ****, Carbohydrates, Proteins, Nutrition. The Merck Manual.*
3. *****. Nutrient Value of Some Common Foods. Health Canada. 1997*. Retrieved 2015-01-25.
4. *R. Olinescu*, *Alimentaţia sănătoasă*, Editura Niculescu, 2000.

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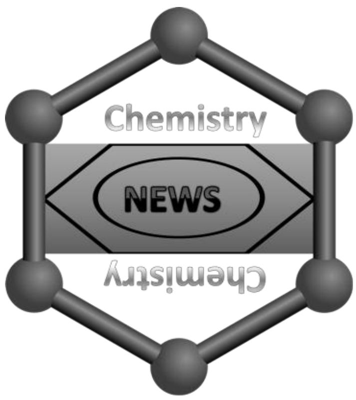

Researchers from the British School of Chemistry, led by Prof. Stephen Mann FRS and Dr. Pierangelo Gobbo, synthetized two types of artificial cells (protocells) with protein-polymer membranes, that differ due to the surface anchored groups. The chemical interactions established between the differend surface groups of the cell membranes resulted in an artificial tissue. Using a thermoresponsive polymer, able to contract or expand when its temperature decreases or increases, around 37 ℃, the artifficial tissue was able to perform sustained beat-like oscillations. By incorporating different enzymes into the constituent artificial cells, the researchers were able to modulate the aplitude of the oscillations (beats) and to control the generated chemical signals.

References

https://www.sciencedaily.com/releases/2018/10/181015113527.htm

The first steps in CHEMISTRY

WOLFRAM – LEGEND AND TRUTH

Wolfram (chemical symbol W), is one of the oldest elements with a strange name linked to ancient medieval legends.

This hard and resistant heavy metal marked the beginning of a real revolution in metalurgy, being well-known since the Middle Age. At that time, the metal melting masters considered occurrence of tungsten a source of discomfort and wasted work. The heavy black or grayish yellow bells of wolfram ore accompanied the tin ore. Due to their heavy weight, the Scandinavian metallurgists called it "tungsten", meaning „heavy stone”.

In the process of tin melting, the "heavy stones" contributed to the formation of foam, which "swallowed" a large part of the tin, decreasing the yield. The XVI century mineralogist Georgius Agricola from Freiberg calls this enemy of tin, which swallowed like a hungry wolf the useful metal, ”lupi spuma”. The german metallurgists called it „Wolfram” from „Wolf” meaning wolf and „Rahm” – cream (foam). No one knew well what was "lupi spuma", so gloomy legends were created around the heavy bumps, requiring extra work to manually choose the useful material [1].

”Tungsten” or „wolfram”, are two words in two languages that would name the same element. Centuries passed and ”lupi spuma” constantly tormented the metallurgists. Nobody knows what was it. Some said it was an altered tin ore, the superstitious, that the heavy stones were sent by the evil spirits of the earth to make lives bitter to those who worked on the tin. Chemists also wonder, "What is it?" [1, 2].

The XVI century Swedish chemist Karl Scheele decided to study the "damn stones". In 1781 Scheele “attacked” the “damn stones” with potassium hydroxide and nitric acid obtaining a precipitate. Its observations on the studied ore (which was in fact calcium wolframate - $CaWO_4$) allowed him to assert that it contained an acid with special properties, which he called tungstic acid from the Swedish name of the stone.

In the same year another Swedish chemist, T. Bergman, showed that tungstic acid is the acid of a new metal which he called tungsten. The name tungsten in English and French is derived from “tung sten” (in Swedish "heavy stone"). Two years later, in 1783, , the Spanish chemists José and Fausto de Elhujar confirmed Scheele’s discovery, by obtaining tungsten through reduction of tungsten trioxide (WO_3) with coal dust. The resulted tungsten was a powder impurified with coal dust. The two chemists considered that the name wolfram is more appropriate than tungsten given by Scheele.

Tungsten is found in nature only as ores, which are chemically tungstates (salts of tungstic acid).

The main ores used in tungsten metallurgy are:

- Scheelite, $CaWO_4$ – calcium tungstate

- Wolframite, $FeMnWO_4$ – an isomorphic mixture of iron and manganesse tungstate. It is named *ferberite* when iron predominates, and *hubnerite* when manganesse is predominant
- Stolzite, $PbWO_4$ – lead tungstate.

Tungsten ores concentrated by mechanical processes are subjected to melting with sodium carbonate (Na_2CO_3), resulting sodium tungstate.

If wolframite is used in the first step, the following reactions occur:

$2WFeO_4 + 2Na_2CO_3 + ½\ O_2 \rightarrow 2Na_2WO_4 + Fe_2O_3 + 2CO_2$

$3MnWO_4 + 3Na_2CO_3 + ½\ O_2 \rightarrow 3Na_2WO_4 + Mn_3O_4 + 3CO_2$

An excess of 10-15% of the required stoichiometric amount of Na_2CO_3 is recommended, and sometimes, 0.5 - 4.0% $NaNO_3$ relative to the weight of the concentrate is added to favor the tungsten decomposition [2, 5].

In the next step tungstic acid is obtained as a precipitate, either directly with hydrochloric acid or via calcium tungstate.

$Na_2WO_4 + CaCl_2 \rightarrow CaWO_4 + 2NaCl$

$CaWO_4 + 2HCl \rightarrow H_2WO_4 + CaCl_2$

Another method is leaching with NaOH.

The main reactions in the leaching phase are of the form:

$FeWO_4 + 2NaOH \rightarrow Na_2WO_4 + Fe(OH)_2$

$MnWO_4 + 2\ NaOH \rightarrow Na_2WO_4 + Mn(OH)_2$

The decomposition takes place in a steel vessel by heating at boiling temperature with a 35-40% NaOH solution, for 4 to 8 hours, under continuous stirring. Then the solution is diluted to double its volume to precipitate other amounts of iron and manganese hydroxides and prevent crystallisation of sodium tungstate [3].

The tungstic acid precipitate is readily separated by filtration and then purified with ammonia (NH_3). Subsequently it is calcined to obtain tungsten trioxide (WO_3), which is reduced by hydrogen or carbon.

$WO_3 + 3H_2 \rightarrow W + 3H_2O$

$WO_3 + 3C \rightarrow W + 3CO$

The tungsten bars thus obtained may be processed by cutting or plastic deformation [3].

Tungsten exhibits a particular influence upon some characteristics of steel. It can be alloyed with steel (2-3%) to obtain special, very hard steels, which wear out hard, the pure metal being brittle.

Tungsten has a silverish-white color and crystallizes in the cubic system. It is a malleable metal, ductile and, very resistant in its pure form. The tensile strength of a tungsten wire can reach up to 400 daN / mm².

These properties associated with a high melting temperature (> 3000 °C), allow the use of tungsten in electronics and electrotechnics. It is used for the construction of filaments of incandescent wire lamps and electronic tubes, anodes of radiogenic tubes (e.g. Roentgen instruments) and high-power electronic tubes [5].

Tungsten presents high density and hardness, properties that recommend it for the manufacturing of cutting heads for drilling machines, and drills. Due to its high density, tungsten is also used for rays protection shields [3]. The shielding effect is better than that of lead, but it is less often used due to higher costs and difficulties during the processing stages.

Also, missils with tungsten carbide core, or amunition containing many small tungsten arrows [AHEAD (Advanced Hit Efficiency and Destruction), a type of ABM (Air Burst Munition)] are more expensive than the corresponding ones made of depleted uranium, but they are neither toxic, nor radioactive.

In a compact form, wolfram does not burn, but as powder it ignites easy.

References

1. A. Băltărețu, *Aventuri în lumea chimiei*, Editura Ion Creangă, 1972.
2. C. D. Nenițescu, *Chimie generală*, Editura didactică și pedagogică, 1985.
3. E. Beral, M. Zapan, *Chimie anorganică*, Editura Tehnică, 1982.
4. http://www.sim.tuiasi.ro/wp-content/uploads/Carcea3-C.Roman-R.Chelariu-Ingineria-proceselor-metalurgice.pdf
5. V. Tudor, *Lexicon de chimie pentru chimie*, Editura Humanitas 1998.

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JOKES

☺ „A friend asked Picasso: „Pablo, how do you have no painting of yours in the room?"
- "I like very much some of them, but they're too expensive to let me buy them," replied the painter."

☺ „To give up alcoohol drinking you need a lot of strength!" [http://www.f3n.ro/index.php/2016/12/02/sa-radem-impreuna-cateva-proverbe-si-aforisme-interesante/]

The first steps in CHEMISTRY

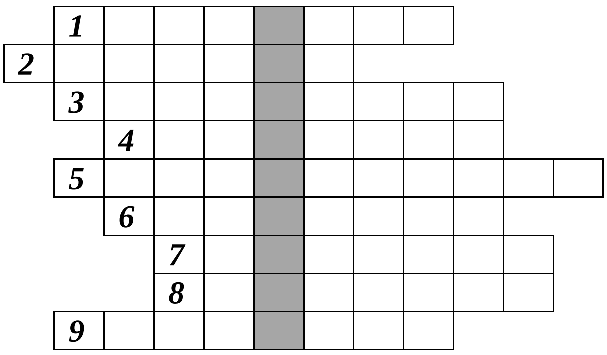
PLAYING WITH CHEMICAL ELEMENTS

CHEM-DOKU: Noble gases (neon, argon, krypton, xenon)

Ne			
	Ar		
		Kr	
			Xe

GUESS THE CHEMICAL ELEMENTS

By solving the following rebus, you can find on the marked vertical line the name of an alkaline metal.



1. Noble gas; ***2.*** The chemical element that may be in the form of graphite or diamond; ***3.*** Silverish-white precious metal used in jewelry and in laboratory equipments. Its name is derived from the Spanish version of the expression "little silver"; ***4.*** Radioactive element chemically symbolized by only one letter; ***5.*** The chemical element with Z = 15; ***6.*** The chemical element with the atomic number 83; ***7.*** The alkaline metal which is the third element in the periodic table; ***8.*** In the periodic table this chemical element is situated in the same group with oxygen, but in the next period; ***9.*** The halogen existing as a fuming red-brown liquid at room temperature.

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CHEMISTRY as passion

COLOUR

In memoriam Corneliu Tărăbăşanu-Mihăilă

Each year, in the 90's, in May, when chestnuts in the courtyard of the Faculty of Chemistry of the University of Bucharest lit the candles of gentle sunshine, Professor Corneliu Tărăbăşanu-Mihăilă[1] told us about colour and dyes, chemistry, music and life[2]. It was during the selection of the Romanian team participating in the International Chemistry Olympiads, when teachers with different scientific concerns were all fascinated by the pleasure we were talking about. He spoke dully, melodious, like those who were born in Braşov and then studied in Timişoara, and all his stories were full of fun.

Professor Corneliu Tărăbăşanu-Mihăilă at his office

Professor Tărăbăşanu was simply charming!

It was, because unfortunately in February 2006 he passed away. But it will always be in our memory, because life is full of colour.

But what is the colour?

A question that you can answer simply by using the definition in DEX or you can elaborate beyond, into a more elaborated text. This happened to me. I wrote a book[3] in which a subchapter is dedicated to colour, as a tribute to the moments when we listened to the stories of Professor Tărăbăşanu. I selected and adapted a fragment from that chapter, with the hope that you, my dear reader, will feel the same joy and pleasure as I did when I wrote it!

The experiments carried out by *Isaac Newton* in 1666, through which sunlight was allowed to penetrate into an obscure room through a small slit and then decomposed by a series of prisms, carefully weighed, formed the basis of the scientific approach to optics, more precisely to determining how light propagates and behaves. Newton explained the optical phenomena from the perspective of mathematics and showed that light and colours are related to geometrical notions such as rays and beam of rays and become accessible to an observer only by means of a device. Newton's work is regarded as the starting point of optics, as a matrix generating specific elements.

A century and a little later, fascinated by the way a painting has been coloured to

[1] Professor at the Departemnt of Organic Compound Technology and Macromolecular Compounds, University *Politehnica* Bucharest.

[2] in that time he founded CHIMIA magazine, the one you browse today through the efforts and perseverance of Mrs. Iulia Gabriela David from the Department of Analytical Chemistry, Faculty of Chemistry, University of Bucharest.

[3] Badea, I: A. Aplicaţii ale spectrometriei UV–VIS în Chimia Analitică, Ed. Didactică şi. Pedagogică, Bucureşti, 2006.

produce certain aesthetic effects, *Johann Wolfgang Goethe* published in 1810 the work called *Colour Theory*[4], in which the author attempted aesthetic and less scientific justifications. In his work Goethe articulates physiology with physics and chemistry, art theory and aesthetics with craft practice, history of science with the theory of knowledge. But experimental physics, in which Newton consistently detached the object from the subject, triumphed in front of *Goethe*'s theory, in which the subject -and subject formed an indestructible unit.

Colour, as an impression produced by the different constitutive radiations upon the eye, is a complex phenomenon both in terms of its production and its reception. The colour vision[5] mechanisms are based on *Young-Helmholtz*'s theory that the eye perceives separately three fundamental colours (red, green, and blue) because it has specific receptors, represented by three types of cone cells differentiated by the photosensitive substance they contain. Non–uniform concomitant stimulation of the three cell types causes different chromatic sensations, while their equal stimulation causes the sensation of white light. Visual sensation has three different components: light, shape, and colour. Colour vision is the most advanced form of the optical analyzer activity; the human eye can recognize about 150 different colours from the visible field, meaning it can differentiate wavelengths of about 3 nm.

The eye, however, can not distinguish between a single wavelength radiation, as in the case of the yellow of the sodium lamp; when this is decomposed by a prism, it consists of a spectral band with several wavelengths. As a receiver, the eye distinguishes only nuances, not well-defined wavelengths: the yellow colour of a sodium lamp is the same as that of sunflower, although the two are completely different in composition. The sensitivity of the retinent photoreceptors is not equal for the entire visible range, and it is high for radiation with a wavelength of 550 nm, which is why the yellow colour is mainly used for signaling.

In 1876, *Witt* showed that organic compounds are coloured if they contain certain functional groups, called chromosomes. They present double or triple bonds. For example, carotenoids, yellow and red pigments from vegetables and fruits, are organic compounds containing a linear chain with conjugated double bonds, as shown in Figure 1.

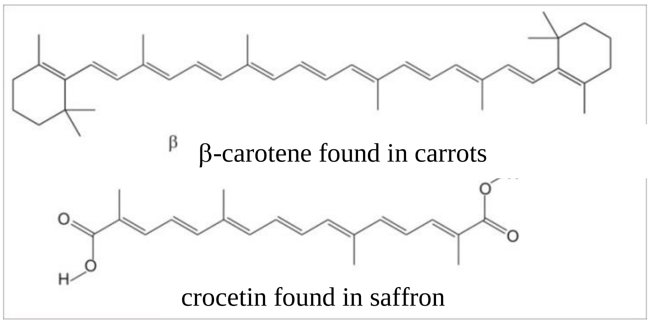


Fig. 1. Structural formulae of pigments found in plants

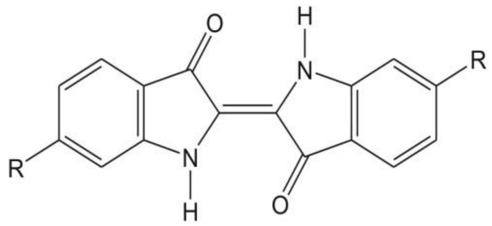
[4] which the author himself says: *I can not imagine anything about everything I created as a poet [...] But in the century that I am living though, I am the only one who knows what is right in the complicated world of colors, this is one thing to be proud of.*

[5] here are two types of photoreceptors in the human retina, rods and cones; rods are responsible for vision at low light levels (scotopic vision), while cones are active at higher light levels (photopic vision)

Molecules having conjugated double bonds are highly coloured. Conjugation increases the intensity of the bands, so very small amount of such pigments are used for analysis, as well as for pharmaceutical and food purposes.

Modifications of conjugation due to the presence of substituents in the molecule can dramatically change the pigment colour, depending on the electron-induced effects of the substituent.

Two indigenous skeleton pigments, known from antiquity and used in the dyeing of fabrics, are indigo and ancient purple. The indigo was isolated from *Indigofera tinctorial*-type plants, and the ancient purple from a mollusk called *Murex brandaris*. The structures of the molecules of the two compounds are shown in Figure 2. One can observe that they differ only by the nature of a substituent: the ancient purple molecule has two additional bromine atoms. The presence of bromine atoms in the ancient purple molecule makes the two natural pigments completely different colours: purple and red-purple.



R – H, indigo, violet
R – Br ancient purple, red

Fig. 2. Structural formulae of indigo (and ancient purple pigments

Anthocyanins, organic compounds in the petal composition, are anthocyanidins glycosides, having absorption spectra with maxima centrered in the 500-545 nm region. Anthocyanins easily participate in proton exchange processes: their structure is heavily influenced by the changes in the environment pH, inducing significant colour changes: the red colour of the roses and the blue colour of the bluegrass is determined by the same cyanide pigment. In the rose petals it is in the form of oxone salt, and in the bluegrass in the form of sodium salt.

Another important class of natural pigments is the one presenting a macrocyclic system, made up of four pyrolytic rings; the basic heterocyclic system is the porphyrin whose structure is shown in Figure 3.

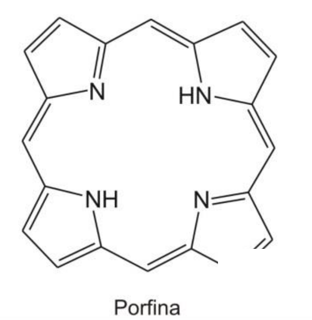


Fig. 3. Structure of porfine

Alkyl porphyrins are substituted at the carbon atoms of the pyrrole rings and are dark red natural dyes. The red pigment in the blood of vertebrates is a chromoprotein made of a protein, globin, and a pyrolytic dye, the hem, a combination of protoporphyrin with Fe (II) ions.

Hemoglobin, which is the oxygen transporter from lungs into cells through the bloodstream, has intense absorption bands in the visible spectrum at 430 nm and 560 nm. In the presence of oxygen, oxihemoglobin is formed, with characteristic peaks at 415 nm, 538 nm, and 578 nm. Spectra of absorption of hemoglobin and oxyhemoglobin are used to detect the carbon monoxide content of the blood: in the presence of carbon monoxide hemoglobin forms carboxy-hemoglobin, with characteristic peaks at 540 nm and 570 nm.

The green leaf pigment, called chlorophyll, is a mixture of chlorophyll A and chlorophyll B, both combinations of porphyrin with Mg (II) ions. The The Russian botanist Michael Tsvet was the first who separated chlorophyll pigments, and founded chromatography[6]. Chemical compounds having a chromophore system are not automatically dyes. Natural and synthetic dyes are coloured substances that have the ability of colouring natural or synthetic materials. A dye is a coloured chemical species, presenting polar or slightly polarizable groups at the ends of the chromophore system, electron donors or acceptors, called auxocroms.

In the category of synthetic dyes, the most important are the azo dyes, used for the dyeing of cellulosic fibers, proteins, and skin. Azo dyes are organic compounds in which the azo group is linked on the aryl radicals or an aryl radical and a heterocyclic radical, or a radical coming from a compound containing an active methylene group. Azo dyes have numerous applications in quantitative analytical chemistry: they are ligands for metal cations or counter ions in the formation of ionic pairs, extractable in organic solvents; in both cases the determination of the species of interest is caaried out spectrometrically.

I do not know if this text has awakened the curiosity of the reader, but I know for sure you will keep using smart phones to preserve colourful moments of life. And then you can also go beyond the image to the scientific field of dyes.

Success!

References

1. Neniţescu, C.D. Chimie Organică, Ed. Didactică şi Pedagogică, Bucureşti, vol I şi II, 1980.
2. Atkins, P. Molécules au quotidien, InterEditions, Paris, 1989.

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[6] Fascinated by the nineteenth-century discoveries, when Nicéphore Niépce associated with Louis Daguerre invented the photography (*write with the aid of light*), and the brothers Auguste and Louis Lumière invented cinematography (*write with the aid of movement*), Tsvet called his method chromatography (*write with the aid of colors*).

INCLUSION COMPLEXES OF MACROCYCLIC RECEPTORS

Part I

Host-guest chemistry

The main objective of host-guest chemistry is studying selective interactions between a host molecule and a guest molecule. *Host* molecules are organic molecules having an internal cavity. With suitable molecules, called *guests*, they form inclusion complexes selectively, based on the structural complementarity and the non-covalent interactions between the host and guest, leading to molecular recognition.

Thus, the host-guest complex formation depends on:

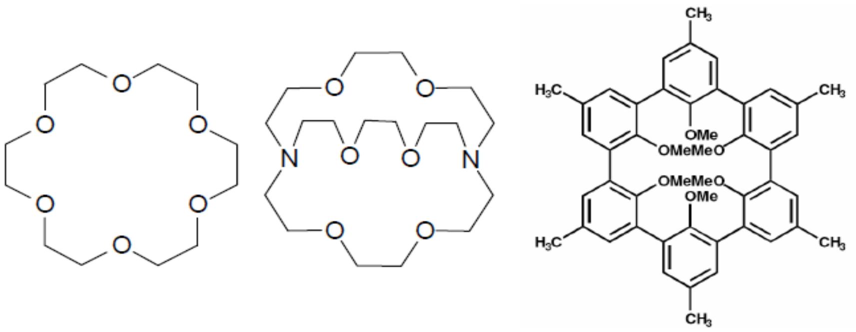
- shape and size complementarity between guest and host;
- the spatial arrangement of the connecting centers; the number of heteroatoms in the polyether cycle of the host;
- the lack of strain in the host;
- the functional groups attached to the host and the nature of the solvent.

The *host-guest chemistry* name was first introduced by Donald J. Cram [1] to describe the chemistry of supramolecular complexes formed between two or more molecules or ions by non-covalent interactions such as: hydrogen bonds, ion-dipole, dipole-dipole, van der Waals forces, π-π staking, cation-π, hydrophobic effects or metal-ligand interactions.

Since Charles J. Pedersen discovered in 1967 the first crown ether, dibenzo–[18]–crown–6, with affinity for K^+ ion similar to the natural macrocycle valinomycin [2], host-guest chemistry has rapidly increased. Valinomycin facilitates the transport of potassium ions through a mitochondrial membrane, in biological systems.

In 1969 Jean-Marie Lehn has synthesized the *cryptands* receptors, three-dimensional derivatives of crown ethers with nitrogen in their structure near carbon and oxygen [3] and Donald J. Cram has synthesized the *spherands* receptors, receptors forming inclusion complexes with various organic, inorganic or biological molecules (Figure 1). For their contributions in the field of supramolecular chemistry, Pedersen, Lehn, and Cram received the Nobel Prize in Chemistry back in 1987.

The supramolecular chemistry is defined as "*chemistry beyond the molecule*" by J.-M. Lehn. Also, supramolecular chemistry is defined as "*chemistry of molecular assemblies and intermolecular bonds*". Moreover, in 2016 the field of supramolecular chemistry won the second Nobel Prize of Chemistry awarded to Jean-Pierre Sauvage, Sir J. Fraser Stoddart, and Bernard L. Feringa for their contributions in introduction and advance of molecular machines.



(a) (b) (c)

Fig. 1. (a) Crown ether (18-crown-6), (b) cryptand [2.2.2], (c) spherand

Compared to molecular chemistry, based on covalent bonds (strong bonds), supramolecular chemistry is based on non-covalent intermolecular bonds (weak bonds). The following methods are used for the characterization of host-guest complexes: UV-Vis and fluorescence spectrometry, nuclear magnetic resonance (NMR) spectrometry, circular dichroism spectrometry, X-ray diffraction, chromatographic, electrochemical, and calorimetric techniques.

Over the last few years, supramolecular chemistry has particularly advanced due to the studies on the design of supramolecular architectures to mimic processes specific to biological systems, as well as potential applications of host-guest complexes and molecular devices [4].

Also, principles such as self-assembling, self-organization, and self-replication specific to the biological systems are found in supramolecular chemistry. In the last two decades, supramolecular chemistry has had a significant impact on the development of analytical chemistry, which includes chemical analysis and instrumental analysis [5].

Molecular recognition

The selectivity of the host towards the guest molecule, based on steric complementarity, leads to the principle of molecular recognition (Figure 2). In the biological system, this “lock and key” steric fit concept *(Schloss-Schlüssel-Prinzip)* introduced by Emil Fisher [6] in 1894 is found in high specific processes such as: enzymatic reactions, antigen-antibody association or substrate binding by receptor protein. Molecular recognition is the central issue in supramolecular chemistry.

Macrocyclic receptors used in inclusion complexes

Macrocyclic receptors (crown ethers, cryptands, cyclodextrins, calix[*n*]arenes, cucurbit[*n*]urils, hemicucurbit[*n*]urils and pillar[*n*]arenes) and their derivatives have the property of forming stable and selective complexes with a suitable substrate by non-covalent

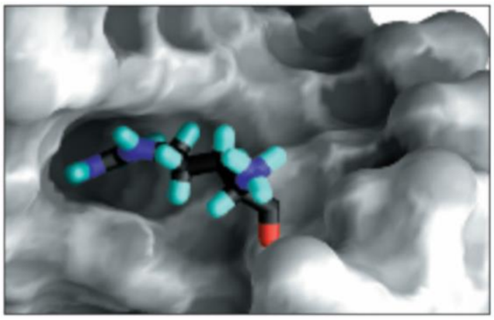


Fig. 2. Complementary fit macromolecule-molecule [7]

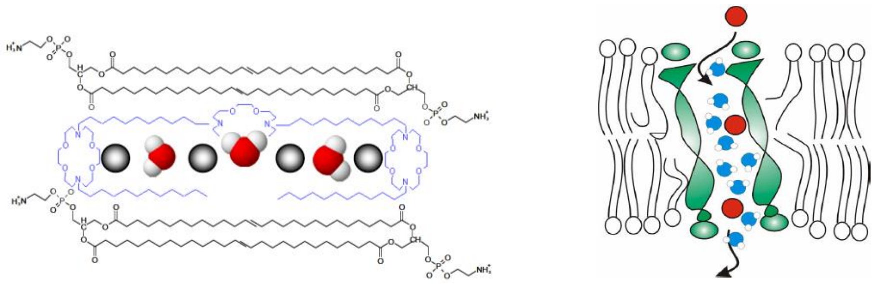
bonds. Obviously, the shape, size, and flexibility of both the substrate and the host influence the complex stability. The development of new classes of macrocyclic compounds with special properties has opened way to applications in various fields such as molecular devices, new materials, catalysis, separation processes or the drug industry.

Crown ethers, cryptands

The macrocyclic ligands are natural or synthetic organic compounds having in the molecule simple bonds of the C-C and C-X (X being a heteroatom: O, N, P) type or conjugated bonds such as benzene ring (Figure 1).

The design and synthesis of macrocyclic receptors with predefined structure has led to obtaining new materials used in the construction of rotaxanes, catenanes, pseudorotaxanes or supramolecular polymers.

In addition to their complexing properties, crown ethers can be used as mobile carriers in liquid membranes or ion channels (Figure 3). The development of synthetic ion channels using crown ethers for the selective transport of protons, Na^{+}, K^{+} and Ca^{2+} cations through liquid membranes allows the study of biological ion channels responsible for the normal functioning of biological cell.



(a) (b)

Fig. 3. (a) Artificial ionic canal [8]; (b) transport through ionic canal

Macrocyclic receptors like crown ethers form inclusion complexes with primary ammonium ions through three hydrogen bonds (Figure 4).

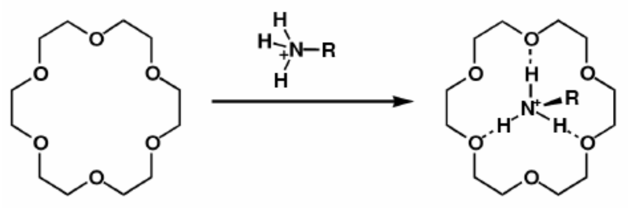


Fig. 4. Inclusion complex of ammonium ion with 18-crown-6

Because of their spherical cavity, the cryptands (three-dimensional structure) are good receptors for alkaline, alkaline earth metals and ammonium ion to form more stable complexes than crown ethers (Figure 1). The formed complexes are called *cryptates*.

A description of other important macrocyclic receptors can be found in issue 5 of CHIMIA journal.

Conclusions

The design of supramolecular architectures based on non-covalent interactions that mimic processes specific to biological systems is a remarkable property of macrocyclic receptors.

Also, the development of molecular machines leads to deciphering the complex mechanisms of biological systems. Separation of chiral compounds with chiral macrocyclic receptors is an application of interest in the chemical, pharmaceutical and medical area.

References

1. D. J. Cram, J. M. Cram, *Host-guest chemistry*, Science, 183, 803-809, 1974.
2. C. J. Pedersen, *Cyclic polyethers and their complexes with metal salts*, J. Am. Chem. Soc., 89, 7017-7036, 1967.
3. B. Dietrich, J. M. Lehn, J. P. Sauvage, *Diaza-polyoxa-macrocycles et macrobicycles*, Tetrahedron Lett. 10, 2885-2888, 1969.
4. C. J. Bruns, J. Fraser Stoddart, *The nature of the mechanical bond: from molecules to machine,* Wiley-VCH, 2016
5. L. You, D. Zha, E.V. Anslyn, *Recent advances in supramolecular analytical chemistry using optical sensing,* Chem. Rev. 115, 7840−7892, 2015.
6. E. Fisher, *Einfluss der Configuration auf die Wirkung der Enzyme*, Ber. Deutsch. Chem. Ges., 27, 2985 – 2993, 1894.
7. L. Stryer, *Biochemistry*, Fourth Edition, W.H. Freeman and Company, New York, 1995.
8. G. M. Gokel, A. Mukhopadhyay, *Synthetic models of cation conducting channels*. Chem. Soc. Rev. 30, 274-286, 2001.

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EXPERIMENTS. TRY IT YOURSELF!

„Lava lamp”

Necessary materials: You need a transparent tall plastic jar (or an empty bottle of 500 mL), food dye (preferable red colour), vegetable oil, an effervescent tablet.

How to proceed? Pour 200 mL of water into the jar/bottle. Add a few drops of food dye. Mix the content thoroughly. Add 200 mL of vegetable oil. Wait a few minutes until you notice a good separation of the two immiscible liquids (water - oil). Drop the fizzy tablet into the jar.

What to notice? In contact with the water phase, the fizzy tablet starts to generate carbon dioxide gas. The gas bubbles rise through the water phase and continue their movement up through the oil phase creating the „lava lamp” effect. When the fizzy table is consumed, a new one will start the reaction again.

Have fun!

Fizzy bath ball

*Necessary materials***:** You need a plastic ball, a spoon, 10 g starch, 30 g sodium bicarbonate, 15 g citric acid, food dye (optional), sodium chloride (salt), 2 mL liquid soap, lavender essential oil (or any other) and vegetable oil (sunflower or olive oil, almond oil, etc).

How to proceed? Put the sodium bicarbonate, citric acid, starch, and salt into the dry plastic ball. Mix them thoroughly with the spoon. Add 1-2 drops of food dye and 2-3 drops of essential oil. Mix them thoroughly with the spoon again. Add the liquid soap and stir them again. Add small amounts of vegetable oil and stir well till you can make some small balls out of the material. Once formed, let the fizzy balls harden. Now everything is prepared for a perfumed, hydrating and fun bath.

What to notice? In contact with the water, the sodium bicarbonate reacts with the citric acid generating carbon dioxide. The gas helps the oil dispersion into the water bath and the quick release of the volatile compounds into the bathroom.

Enjoy the fun!

Dr. ing. Cristina TODAȘCĂ
University Politehnica of Bucharest. Faculty of Applied Chemistry and Materials Science

CHEMISTRY in exercises and problems

Problemes for beginners

ALLOYS - EXERCISES

1. The copper alloy with aluminium is a chemical compound which contains 12,3% aluminum. Establish the formula for this compound.

2. What kind of acid - hydrochloric or nitric - can be used to remove copper from alloys? What would be the cause?

Write the equations for the chemical reactions which happen between the Copper and that acid.

Prof. Marinela ȘUICĂ
„Sf. Nicolae'' Elementary School, Bucharest

- ❖ 150 years since Dimitry Mendeleev discovered the periodic table of chemical elements, in 1869. To highligh the importance of the periodic system for science and technology UNESCO proclaimed 2019 as **„International Year of the Periodic Table of Chemical Elements (IYPT2019)"**. [https://www.iypt2019.org/]
- ❖ Under the motto "100 Years of Creating a Common Language for Chemists" the International Union of Pure and Applied Chemistry (**IUPAC**) celebrates 100 years of existence. [https://iupac.org/100/]
- ❖ We celebrate the Centenary of the Romanian Chemical Society (**SChR**).
- ❖ France celebrates during the 2018-2019 school/academic year **"The year of chemistry, from primary school to university"**. [http://eduscol.education.fr/cid123019/annee-de-la-chimie-2018-2019.html]

CHEMISTRY in exercises and problems

Problems for Enthusiasts

FLUORIMETRIC DETERMINATION OF QUININE CONTENT OF TONIC WATER

Fluorimetry is a sensitive analytical technique based on the molecular emission of radiation (fluorescence) [1]. At low analyte concentrations there is a direct proportionality between the analyte concentration and the signal (I_e, intenisty of the radiation emitted by the sample, expressed in arbitrary units –a.u.) measured using a fluorimeter (molcular emission spectrometer) according to the relation:

$$I_e = \text{constant} \times C_{analyte}$$

Quinine is an alcaloid used in the malaria treatment. Quinine can be found in tonic water, at low concentrations having thus no negative effects [2]. Because it is a strong fluorescent compound in dilute H_2SO_4 solution [3], the quinine content of tonic water can be determined by fluorimetry using the single volume standard addition method with the same final volume. Thus, a volume of 0.1 mL of tonic water was diluted with 0.1 M H_2SO_4 in a 10 mL volumetric flask. A fluorescence intensity (I_{e1}) of 8.62 a.u. was measured for this sample. In another 10 mL flask were added 0.1 mL sample o tonic watr, 0.15 mL quinine sulfate standard solution having a concentration of 50 ppm (1 ppm = μg / mL) and brought to mak with 0.1 M H_2SO_4. The fluorescence intensity (I_{e2}) measured for this sample was 17,57 a.u. How many mg quinine are contained in 500 mL tonic water.

Considering that the FDA (US Food and Drug Administration) provides a maximum admissible content of 83 ppm quinine in tonic water [2], indicate whether the beverage under consideration fulfills the condition imposed by the FDA.

References

1. http://www.schr.ro/doc/revista-chimia/03.pdf
2. https://www.healthline.com/health/quinine-in-tonic-water#benefits-and-uses
3. http://chemwiki.ucdavis.edu/Core/Analytical_Chemistry/Analytical_Chemistry_2.0/10_Spectroscopic_Methods/10.6%3A_Photoluminescence_Spectroscopy

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HENRY LOUIS LE CHATELIER (1850-1936), A LIFE DEDICATED TO CHEMISTRY

[1]

The Le Châtelier principle

If a dynamic stable chemical equilibrium is subjected to an external constraint, the equilibrium shifts in the sense of minimizing the effect of the disturbance.

Biography

Henry Louis Le Châtelier was born in Paris on October 8, 1850 and died on September 17, 1936 in Miribel-les-Échelles.

He grew up in a family with scientific and technical traditions. His father, Louis Le Châtelier, at that time, the general inspector of the mines in France, was commissioned by Napoleon III to begin building the French railway network. Close family members were engineers and scientists involved in the production of limestone and cement, in the railway construction, mining, aluminium and steel production. From his mother side, Henry Louis was the grandson of Pierre Durand's, one of the cement inventors [1, 2].

His mother, Elisabeth Durand, raised her six children (Henry being the eldest) following the strictest standards of education.

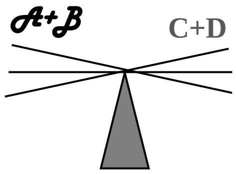
Henry began his studies at the Collège Rollin and enrolled to the Military Academy in parallel, earning the baccalaureate diploma (1867) and graduating the military high school (1868) [3].

In 1869 he started studying at Ècole Polytechnique. During the study he attended Henri Sainte-Claire Deville's lab at the Upper High School. His philosophy professor, Carpentier, helped him understand the relationship between the scientific method and the literary composition and inspires his interest for the humanist domain. In 1871, his studies were interrupted due to the outbreak of the Franco-Prussian War; like all polytechnics students, young Henry is enrolled with the rank of second lieutenant.

Le Châtelier returned to the École Polytechnique and obtained a degree in science and engineering in 1875. Two years later, he became a chemistry professor at École des Mines, where he started his reasearch activity on cements, ceramics and glass. Some of these experiments on cements involved the measurement of very high temperatures but the instrumentation from that time was not adequat. Therefore, he developed a special thermocouple (named thermoelectric pyrometer) based on platinum and a platinum-rhodium alloy. This device, called Le Châtelier's thermocouple, enables the accurate measurement of high temperatures [1, 2].

As a professor at the École des Mines, Le Châtelier took part in the investigations initiated by the French government on the mining explosions that took place in the early 1880s. This activity involved the investigation of the ignition temperature and burning speed of some materials existing in the undergorund, as well as other conditions affecting the explosions produced in mines. Le Châtelier results, applied to acetylene combustion, led to the subsequent invention of the oxyacetylene flame, used also in the present for cutting and welding steel. During this period, Le Châtelier contributed also to the manufacturing of safer explosives and improved the miner's safety lamp, invented in the early 1800s by Humphry Davy.

Le Châtelier investigated chemical reactions occurring in steel manufacturing furnaces.



Le Châtelier's scientific experience culminated with the discovery for which he is best known today - THE LE CHÂTELIER'S PRINCIPLE. According to this principle, formulated in 1884, *if a stable chemical equilibrium is subjected to an external constraint, the equilibrium shifts in the sense of minimizing the effect of the disturbance.* In essence, the principle provides the direction in which a chemical reaction moves when one of the following parameters change: pressure, temperature, composition of the chemical system in equilibrium, the use of catalysts [2].

Le Châtelier deduced mathematical equations describing the chemical systems in equilibrium. Regarding this topic, the famous French chemist admitted later that the American mathematician Josiah Willard Gibbs was the one who, in 1876 - 1878, partially offered the mathematical solutions for describing chemical equilibria. Consequently, in 1899, Le Châtelier devoted a year to studying this issue, after which he translated Gibb's original work on chemical equilibria [4].

Using Le Châtelier's principle, researchers have optimised various chemical processes. For example, Fritz Haber applied Le Châtelier's principle to developing a practical procedure for ammonia synthesis employing hydrogen and nitrogen. Le Châtelier himself tried this synthesis, but he gave up when the gaseous mixture exploded.

Le Châtelier continued teaching. He was professor at the Collège de France and Sorbonne. After working for the French government during the First World War, he retired from the École des Mines in 1919, at the age of 69. [2].

Throughout his professional and scientific career, he taught and published several papers on different topics, including: Combustion Processes (1898); The Theory of Chemical Equilibria (1898-1899); Properties of Metall Alloys (1899-1900); High Temperatures Measurements (1900, coauthored with Boudourad); Iron Alloys (1900-1901); General Methods of Analytical Chemistry (1901-1902); Silica and its compounds (1905-1906); Practical Applications of the Fundamental Principles of Chemistry (1906-1907); Properties of Metalls and Teir Alloys (1907). Carbon and the general laws of chemistry (1908); Introduction to the metallurgy study (1912); Silica and silicates (1914) [1, 5].

In 1907 he became a member of the Royal Swedish Academy of Sciences and of the French Academy of Sciences.

He was married to Geneviève Nicolas, with whom he had four girls and three boys. Five of his children followed scientific careers [5].

On January 22, 1922, Henry Le Châtelier was celebrated in one of the Sorbonne amphitheatres for his 50 years of scientific activity. On this occasion, he was awarded a gold medal (made by the sculptor Lamourdedieu), having engraved on one side his face and on the other, the chemist in the laboratory, surrounded by the devices he used for his studies. The event was organized by a committee of 130 members (the sum of 170,000 francs was used to organize the celebration but also to pay for the gold medal) [6].

To remember

Here are some of the thoughts Le Chatelier transmitted to the audience at this anniversary moment

" I cannot recommend enough to the young chemists to show modesty and not to follow the first impulses to question all the science built with much labor by their ancestors. Thanking, on the contrary, being pleased to add a few commands to a chain reinforced by others. ... You make discoveries when you can and not when you want!"

" *Human life is like a huge mechanism whose organs are linked to each other and whose movement is driven by a power that escapes our control. Our free arbiter intervenes only to ensure the smooth operation of the machine with full growth, to lubricate the wheels, to tie the parts between them ... The transgression of human laws and those of nature lead to the stop the car*."

" Discipline and respect for laws are the source of all the sciences, ... of the whole civilization. Discipline is the voluntarily respect for law, either the social, established by humans, or the scientific one, that we find written from the beginning of time in the great book of nature." [6]

Nota bene

As a child, Henry Le Châtelier was not attracted by the exact sciences, but the home education, the father's passion for science and the meeting with teachers passionate about the disciplines they taught and the work with the students, decided the professional path he embraced with dedication, leaving invaluable scientific treasures to the world.

This is what the scientist said, after a life dedicated to the science of chemistry.

” *I did not understand anything of mathematics and was among the last three in the class. He took me (the teacher) with calm and made me realize that my father was among the first in his class. After every hour, he took me a few minutes, explained my heavier parts again and listened to me. ... It was a miracle for me. I started to solve geometry problems without interruption. After a few weeks I became the first in the class and have remained so ever since. Without this teacher, I would never have reached the Ècole Polytechnique. ... My father had decided ideas on science. ... My father did everything to guide me toward science and succeeded.”* [6]

References

1. http://www.heurema.com/POFQ-LeChatelier.htm
2. http://www.madehow.com/inventorbios/23/Henry-Louis-Le-Ch-telier.html
3. C. H. Desch, Henry Louis Le Chatelier (1850-1936), *Obituary Notices of Fellows of the Royal Society* 2(6), 250-259, 1938. (https://www.jstor.org/stable/769060?seq=1#page_scan_tab_contents)
4. M. Lette, Henry Louis Le Châtelier - French chemist, https://www.britannica.com/biography/Henry-Louis-Le-Chatelier#accordion-article-history
5. https://www.revolvy.com/page/Henry-Louis-Le-Chatelier
6. G. Longinescu, Henry Louis Le Chatelier, în *Natura, Revistă Pentru Răspândirea Științei*, sub îngrijirea domnilor G. Țițeica, G.G. Longinescu, O. Onicescu, nr. 8, anul XXV, 1-8., 1936

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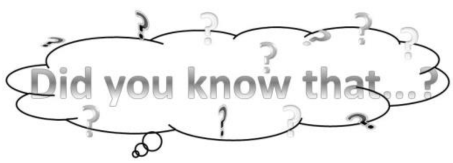

... oxygen can have different oxidation states. Being an electrongative element, in most compounds (e.g. H_2O, Na_2SO_4*) oxygen has the +2 oxidation state. In peroxides (e.g.* H_2O_2, H-O-O-H*) its oxidation state is -1, whereas it has the +1 oxidation state only in combination with the most electronegative element of the periodic table, namely in oxgen difluorde,* OF_2 *(*F-O-F*).*

[https://www.khanacademy.org/science/chemistry/oxidation-reduction/modal/v/unusual-oxygen-oxidation-states]

INTERVIEW

with **Cristian Nicolae Macovei**, from the national College „Bogdan Petriceicu Hașdeu" Buzău, who obtained the highest score and thus the first prize at the National Chemistry Competition "Raluca Ripan", held from 8 to 10 June 2018 in Bucharest

- *Cristian, please tell us something about you.*

It's not easy for me to talk about myself. I could characterize myself by saying that I am a cheerful, curious, and sedulous child: when a domain wakes up my interest, I do not stop until I deepen it. I could say I'm easily introverted, but I have a group of friends with whom I feel very well, we have common concerns and it is enough for me. I also love sports, I like playing tennis and basketball, and I love walking with my friends.

- *Why did you choose to participate in the chemistry „Olympiad" starting with the first year you had contact with this discipline at school? What attracted you towards chemistry?*

My interest in chemistry was awakened in the 5th grade when I participated in an experiment conducted by the 8th grade students in which they presented us a spectacular reaction, similar to the volcano eruption. Now I know it's about the decomposition of ammonium dichromate. Later, my interest increased suddenly as I entered the lab, where I discovered a lot of recipients filled with substances that stirred my curiosity to study and discover their secrets.

- *What did your qualification and participation in the national stage of the chemistry "Olympiad" for the 7th grade, known as the "Raluca Ripan" National Contest, meant to you?*

For me, attending the Raluca Ripan Chemistry Competition meant first the work and then the reward: an extraordinary joy. I was proud and honored to take part, I am a representative of my county and I hope to participate in the next editions. Last, but not least, the enormous gain I've had there have been a few friends I've made and kept in touch with through social networks and I hope to see each other on holidays or on other competitions.

- *Can you share with us some impressions about the national stage of the "Raluca Ripan" National Contest 2018, at which you won the first prize by obtaining the highest score?*

First, I was impressed by the exercises and problems from this contest, which we expected to be inaccessible and which, in turn, proved to be interesting and solvable. I was impressed, proud and happy when I stepped into the "Politehnica" University, and Minister Ecaterina Andronescu congratulated me and handed me a diploma.

- *What are your future plans? Do you want to continue participating in chemistry Olympiads and competitions in the future?*

Of course, my plans include participation in chemistry competitions and assiduous study to achieve exceptional results. My goal is not only to participate in national competitions and Olympiads, but to overcome my country's physical and educational boundaries.

- *What other subjects / disciplines do you like? Have you ever thought what job you would like to have in the future?*

There are many areas that make me enthusiastic, such as: medical engineering, genetic engineering, scientific research, CERN (European Organization for Nuclear Research). I do not know much about what these domains mean, but research captivates me, and I wish I could combine chemistry with physics and computer science, which also fascinates me.

- *We wish you good luck and hope to continue your journey to the mysteries and beauties of CHEMISTRY.*

Societatea de Chimie din ROMÂNIA
„CHIMIA - Revistă pentru elevi"
acordă
MENȚIUNE SPECIALĂ
Elevei/elevului SZEBENI A. AMALIA MARIA
de la
pentru rezultate deosebite obținute de
CEL MAI TÂNĂR participant la
CONCURSUL DE CHIMIE „RALUCA RÎPAN" - 2018
Etapa Națională
Ediția a XIV-a
Data,
PREȘEDINTE COMISIE, Prof. Dr. Irinel-Adriana BADEA
PREȘEDINTELE SOCIETĂȚII DE CHIMIE DIN ROMÂNIA Prof. Dr. Ing. Sorin ROȘCA

INTERVIEW

with **Amalia Maria Szebeni**, from the "George Coşbuc" Secondary School Sighetu Marmaţiei, Maramureş, who received from "CHIMIA – Journal for Students", *The special mention for the outstanding results of the youngest participant* at the National Chemistry Competition "Raluca Ripan", held from 8 to 10 June 2018 in Bucharest.

- *Amalia, please tell us something about you.*

  My name is Szebeni Amalia Maria, I am 12 years old, and I am a 7^{th} grade student at "George Coşbuc" Secondary School in Sighetu Marmației, Maramureș County.

- *Why did you choose to participate in the chemistry „Olympiad" starting with the first year you had contact with this discipline at school? What attracted you to chemistry?*

In the 5th grade, my parents gave me the book "The Mysteries of CHIMISTRY". Since then I have been impatient to unravel other mysteries of this matter. In the 7th grade, I met (as a teacher at my class) the chemistry professor Dragoş Reghina, a person devoted to his work, a consummate pedagogue, patient, but also demanding, who inspired my love for this science.

- *What did your qualification and participation in the national stage of the chemistry "Olympiad" for the 7th grade, known as the "Raluca Ripan" National Contest, meant to you?*

The qualification and participation in the national stage of the "Raluca Ripan" Contest was a great joy, a new challenge, and the crowning of the work done so far.

- *Can you share some impressions about the national stage of the "Raluca Ripan" National Contest 2018, where you have been the youngest participant?*

Regarding my age, compared to the other participants, I have felt no difference. At school competitions it happened sometimes to be asked what class I am, or to be directed to the classrooms with pupils in smaller classes.

My participation in the national stage of the "Raluca Ripan" Contest held in Bucharest from 8th to 10th June 2018, was an opportunity, perhaps unique in my life, to meet Romanian university's personalities, to make new friends, to visit important places in Bucharest, and to go for the first time by train (Baia Mare - Bucharest - Baia Mare).

- *What future plans do you have? Do you want to continue participating in chemistry Olympiads and competitions in the future?*

Considering that I will be the 8th grade, I shall prepare intensively for the national tests, but I will not neglect chemistry, I want to qualify again for the National Stage, but this time I dream for a place on the podium.

- *What other subjects / disciplines do you like? Have you ever thought about what job you would like to have in the future?*

I like all the disciplines, but besides chemistry, I like biology and math.
From the 3rd grade I dream of becoming a neonatologist.

- *We wish you good luck and hope to continue your journey to the mysteries and beauties of CHEMISTRY.*

Thank you!

Interview by Iulia Gabriela DAVID

STUDENTS'
CHEMISTRY

THE FIREWORKS - VISUAL DELIGHTS... FOR ALL AGES!

The topic of fireworks is challenging and interesting for all ages. In this paper we wanted to show what chemical elements are used to get your favorite colors and where their story started. Of course, we can meet them at any New Year party and at various events, being extremely used on all meridians. We are fascinated by the colors produced by the reaction of the chemical elements in the flame. That's why we'll summarize the visual delight created by the colors of the fireworks!

The story of the fireworkshas begun more than 2000 years ago, but the discovery of their actual form is considered to date about 1000 years and is attributed to the Chinese monk Li Tan, who observed that ignition of gunpowder introduced into a bamboo tube results in a spectacular explosion of sounds and lights [1]. Due to the fact that fireworks are something special, every year on the 18th of April the Chinese celebrate this [2] and 90% of the current world fireworks are manufactured in China, whereas the world's largest consumer is Walt Disney Company [3].

Burning or combustion is a rapid chemical reaction between a fuel and an oxidant, accompanied by heat and, sometimes, light (flame). In most combustions the oxygen in the air is the oxidant [4].

The fireworks are mixtures of two or more components, typically oxidant, fuel, binders, and other additives (*e. g.* substances responsible for flame coloration) that give by combustion light, thermal, fumigne, acoustic, or other effects [5, 6].

Now it's time to discover the substances behind the colors that delight our eyes!

Since it would be too much to write about the salts of the elements whose flame reaction we shall describe, we add only some information on the metal responsible for the color of the flame.

- Red – lithium and strontium salts.

Strontium is an alkaline-earth metal, gray-silver, softer than calcium, and much more reactive towards water.

Lithium is a white-silver alkaline metal; under normal conditions it is the lightest metal. Like all alkaline metals, lithium is highly reactive, corrodes rapidly in wet air, losing its gloss and blackening, and is therefore kept under a layer of oil

- Red – orange (iron fillings - Figure 1).

Iron is situated before hydrogen in the metal reactivity series, being di- and trivalent.

Its reactivity is higher when used as filings. It reacts with atmospheric oxygen generating little orange sparks and forms iron (II, III) oxides.

- Yellow-green – barium salts.

The chemical properties of barium are similar to those of calcium and other alkaline-earth metals. Barium reacts with water and oxygen more energetically than most alkaline earth metals and dissolves easily in almost all acids - except concentrated sulfuric acid.

- Green-blue – copper sults.

Copper does not react with water but reacts slowly with atmospheric air; as a result of this reaction, a green oxide layer is formed onto the copper surface.

- Silver – magnesium (bright white - Figure 2) and aluminium (sparkling sparks).

Magnesium compounds, mainly magnesium oxide, are used in the production of iron and steel, in the non-ferrous metals, glass, and cement industries.

Aluminum is widely used in industry due to its resistance to oxidation, its good mechanical properties, and its low density [7].

To observe the visual delight, we chose to carry out the flame reactions of some chemical substances. Below are photos of two of these reactions (Figures 1 and 2).

Fig. 1. Burning of iron powder

Fig. 2. Burning of magnesium

References

1. http://artificii-events.ro/istorie/
2. https://epicfireworks.com/blog/tag/li-tian/
3. https://www.historia.ro/sectiune/general/articol/artificiile-deliciul-vizual-al-sarbatorilor
4. P. Spacu, M. Brezeanu, M. Stan, C. Gheorghiu, *Tratat de chimie anorganică*, Editura Tehnică, Bucureşti 1978.
5. ****Enciclopedia copiilor*, Editura Aquila '93, Oradea, 2000.
6. http://www.creeaza.com/familie/diverse/PRINCIPII-DE-ELABORARE-A-COMPO812.php
7. C. D. Neniţescu, *Chimie generală*, Editura Didactică şi Pedagogică, Bucureşti 1979.

*The authors of this work received the IIIrd Prize at the National Competition" CHEMISTRY-Friend or enemy?!" 2018: Section „Secondary School Students"

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Coordinating teacher: Simona - Veronica BOGDAN
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THE CHEMILUMINESCENCE

Chemiluminescence is the emission of light as a result of a chemical reaction. A large amount of energy is produced during these chemical reactions, that is absorbed by one of the intermediates or a fluorescent pigment, thus reaching an excited, unstable state. When it returns to its stable state of minimal energy, it gives up energy in the form of light [1].

When the atom receives energy from the outside, its electrons are promoted on higher energy levels and the atom goes into an excited state. After about 10 - 100 nanoseconds, the electrons return to the lower levels and will release the energy they received, usually in the form of electromagnetic radiation [2].

Applications of chemiluminescence

1. Forensic

Chemiluminescence is used in forensic to detect and highlight blood traces (Figure 1). A luminol and hydrogen peroxide solution is sprayed over the area where the forensic doctor suspects it would be blood. Iron present in blood hemoglobin catalyses the reaction between the above-mentioned reagents. Since only a very small amount of iron is needed to catalyze the reaction, blood traces can be detected even if they are not visible to the naked eye [3].

Fig.1. Blood highlighted by the luminol chemiluminescence reaction [4]

2. Detection of nitrogen monoxide concentration for the assessement of air quality

The chemiluminescent measurement of the NO concentration in the exhaled air is a new method of diagnosing and monitoring pulmonary inflammation in asthma [5].

The amount of light produced in the NO reaction with ozone (O_3) is directly proportional to the concentration of NO in the air sample and this light can be detected by means of a photomultiplier tube in order to determine the degree of air pollution [6] [7].

3. Entertainment

Light sticks are most often used in entertainment, at parties and concerts. A glow stick is made up of a plastic tube containing a mixture of diphenyl peroxy -oxalate and a fluorescent pigment.

Depending on the pigment used, the color of the resulting light will be different. Inside the plastic tube there is also a smaller glass tube containing hydrogen peroxide. When the stick is bent, the glass tube breaks and the peroxyoxalate is oxidized by hydrogen peroxide in an energy-releasing reaction. The released energy will be taken up by the fluorescent pigment, and it passes into an excited state. On returning in the fundamental state the pigment produces light [8].

4. Bioluminescence

Bioluminescence is the emission of light by a living organism (Figure 2), a particular case of chemiluminescence. It is used by creatures to: attract food, defense, camouflage, mating, and communication [9].

Fig. 2. Panellus stipticus [10]

References

1. http://www.scienceinschool.org/2011/issue19/chemiluminescence
2. http://www.chemistryexplained.com/Ce-Co/Chemiluminescence.html
3. http://science.howstuffworks.com/luminol.htm
4. https://chemincrime.weebly.com/luminol-test.html
5. http://www.theramed.ro/pacienti/astm/niox.html
6. Th. C. Niculescu, R. Cârmaciu. Anatomia și fiziologia omului-compendiu, Ediția a doua, Editura Corint, București, 2009.
7. V. Ranga, I. Teodorescu Exarcu, Anatomia și fiziologia omului, Editura Medicală, București, 1970.
8. http://science.howstuffworks.com/innovation/everyday-innovations/light-stick1.htm
9. http://animals.howstuffworks.com/animal-facts/bioluminescence.htm
10. https://ethericecology.wordpress.com/2018/04/23/what-is-lit-life/panellusstipticusjuly5_2010_cropped/

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STUDENTS' CHEMISTRY

PROTEINS AND THEIR IMPORTANCE IN THE FOOD INDUSTRY

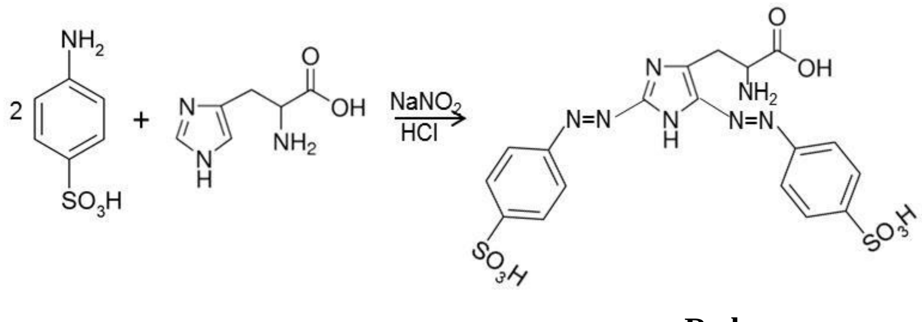
Nutrition in the general sense is a recent science because it appeared shortly before the middle of the 20th century. It is the result of basic disciplines such as biochemistry and physiology, which allow the definition and understanding of the nutritional requirements of animals and humans [1].

Unlike plants and numerous bacterial species, birds as well as superior animals are incapable of synthesizing the essential amino acids they need for protein synthesis and tissue development, largely depending on the quality of the feed recipe. Combined feed contains complex nutriments obtained industrially by mixing various leguminous plants, vitamins, and mineral salts [2]. They prevent the occurrence of debilitating diseases and ensure the maintenance of the animal health status, reducing the livestock losses [3]. The most representative features are the percentage of protein and metabolizable energy, as well as constitutive amino acids, vitamins, and minerals [4].

In our experimental work, we sought to identify the amino acids by their specific color reactions and a series of quantitative determinations (humidity and crude protein content). The sample to be analyzed was obtained by mixing 50 g feed with 200 mL water. After 30-40 minutes it is stirred from time to time and filtered on a pleated filter to obtain a clear protein solution [5].

Qualitative analysis

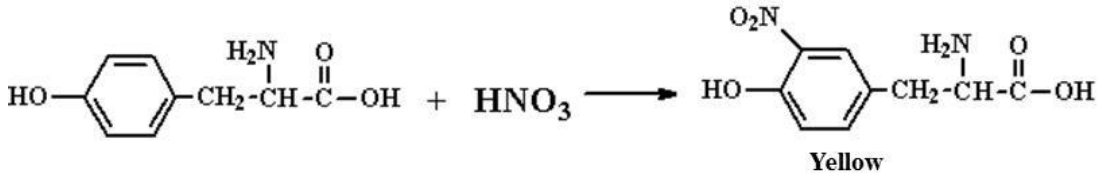
The **Pauly reaction** revealed the presence of the imidazole ring in histidine and the phenolic group of tyrosine in the analyzed sample, as a red color developed in the solution due to the formation of an azo dye between the diazonium salt of the sulfanilic acid and the imidazole ring of histidine, in the alkaline medium [5].



Red

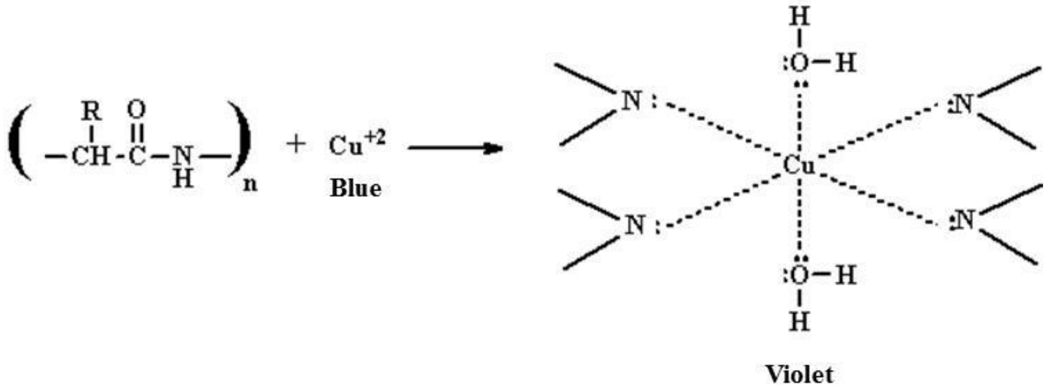
The xantoproteic reaction. By treating the protein sample with concentrated nitric acid, a yellow precipitate was observed. The color is enhanced by the addition of alkali hydroxide, changing into orange, as a result of the nitro phenoxides formation.

The reaction is due to the phenolic groups of tyrosine and phenylalanine (the presence of the aromatic nucleus in the sample) [5].



[6]

The biuret reaction involves treating the strongly alkaline protein sample with $CuSO_4$ solution. The development of violet or blue-violet color thus confirms the presence of peptides having at least three amino acids in their structure, i.e., two peptide bonds [5].



[6]

Sulfur is identified by boiling the sample with $Pb(CH_3COO)_2$, in alkaline medium. A black PbS precipitate appears. PbS can also be recognized by solubilization with a strong mineral acid (HCl), releasing H_2S, with a rotten eggs smell. The reaction is due to the presence of amino acids with thiol groups (-SH) in the sample to be analyzed (methionine, cysteine) [5].

$$\textbf{Protein-S} + 2\ NaOH \rightarrow Na_2S$$

$$Na_2S + Pb(CH_3COO)_2 \rightarrow PbS\downarrow + 2\ CH_3COONa \text{ [7]}$$

Quantitative determinations

Determination of feed humidity consists in grinding the sample and dehydrating it under certain conditions (oven type, time and drying temperature) specific to the nature of the feed. The decrease of the feed weight after drying was determined by weighing [8].

The content of crude protein in the feed is evaluated on the basis of the nitrogen content, determined by the Kjeldahl method.

(1) The sample is dissolved in sulfuric acid in the presence of a catalyst (CuO or $CuSO_4 \cdot 5H_2O$) [8] and heated. The organic nitrogen is converted to NH_4^+, which in the presence of H_2SO_4 forms ammonium sulfate.

$$\textbf{Protein-N} + H_2SO_4 \rightarrow CO_2\uparrow + H_2O\uparrow + (NH_4)_2SO_4$$

(2) The acid solution was alkalinized with sodium hydroxide to liberate NH_3.

$$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3\uparrow + Na_2SO_4 + H_2O$$

(3-5) The released ammonia is liquefied and retained in a collecting vessel containing a boric acid solution (H_3BO_3 or $B(OH)_3$) and a few drops of a mixture of methyl red and bromo crezol green indicators (Figure 1). When NH_3 reacts with boric acid, the color of the solution changes from pink to green due to the indicator conversion.

$$NH_3 + H_3BO_3 + H_2O \rightarrow NH_4^+ + B(OH)_4^-$$

NH_3 from the boric acid solution is titrated with HCl solution until the first appearance of the pink color (Figure 2).

$$NH_3 + H_3BO_3 + H_2O \rightarrow NH_4^+ + B(OH)_4^-$$

The crude protein content is obtained by calculation.

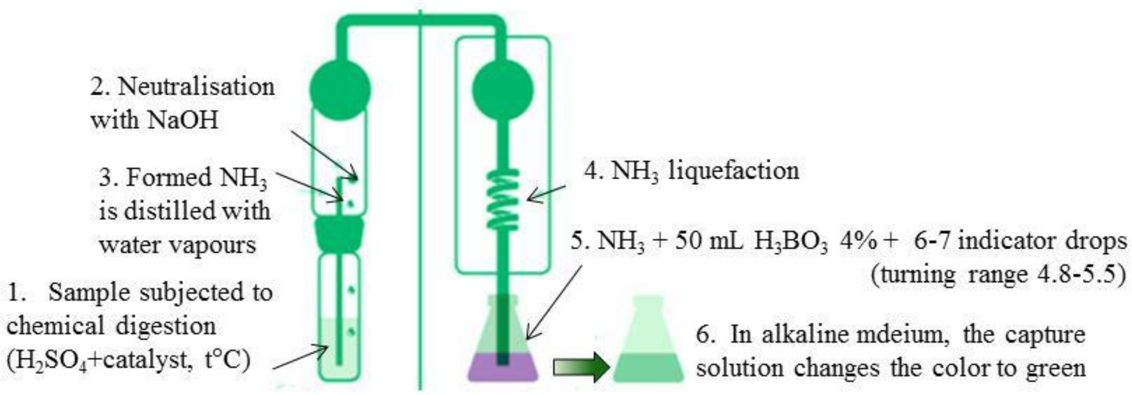


Fig. 1. Schematic representation for the total potein content determination in feed [9]

Fig. 2. HCl titration of ammonia resulting from the feed sample digestion.

Conclusions. Following qualitative identifications, the analyzed feed sample contains the following amino acids: histidine (imidazole ring - aromatic), tyrosine (aromatic ring), phenylalanine (aromatic ring), cysteine, cystine, methionine (amino acids with thiol groups or sulfur bridges). The percentage of protein in feed and feed humidity were determined by quantitative analysis (Table 1).

Table 1. The experimental results of the feed samples analysis

Analyzed samples	Protein (%)	Humidity (%)
Feed sample 1	20.30	8.94
Feed sample 2	20.47	9.02
Feed sample 3	20.43	8.87
Feed sample 4	20.84	8.97
Feed sample previous analyzed	20.92	8.93

It should be noted that the presence of the following amino acids positively influences the growth and development of the birds: methionine – it plays a role in the feathers formation; choline and lysine - influence the quality of the meat (it has a non-homogeneous composition, the chest meat is white, rich in protein, and the rest of the body has a lower amount of protein, but it is richer in fat) [10] and the formation of avian antibodies: aspartic acid and threonine - influence the activity of enzymes, hormones and antibodies; ossein - has a role in the metabolism of bones (the ossein is a protein of the same nature as collagen), which is part of the organic fraction of the bone tissue. The proportion of ossein in bones varies with age and function: bones with high elasticity and the younger ones have a higher proportion of ossein, and the most rigid and long-lasting bones have fewer ossein, this is why they are more fragile.

References

1. M. Larbier, B. Leclercq, *Nutriția și alimentația păsărilor*, Editura „Alutus-D", București 1994, pg 11.
2. https://dexonline.ro
3. ***www.revista-ferma.ro
4. https://www.agroland.ro
5. A. Ciocioc, N. Vlăsceanu, *Lucrări practice de chimie organică pentru licee*, Editura „Scrisul Românesc", Craiova 1983, pg. 197-199.
6. http://people.uwplatt.edu/~sundin/351/351h-pro.htm
7. http://vlab.amrita.edu/?sub=3&brch=63&sim=1094&cnt=1
8. ***Regulamentul de stabilire a metodelor de eșantionare și analiză pentru controlul oficial al furajelor, 152/2009.
9. https://www.itwreagents.com/download_file/brochures/A173/de/A173_de.pdf
10. I. Văcaru-Opriș, *Tratat de Avicultură*, vol. I, Editura „Ceres", București, 2004, pg.105.

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STUDENTS'
CHEMISTRY

THE BLUE BLOOD'S POISON

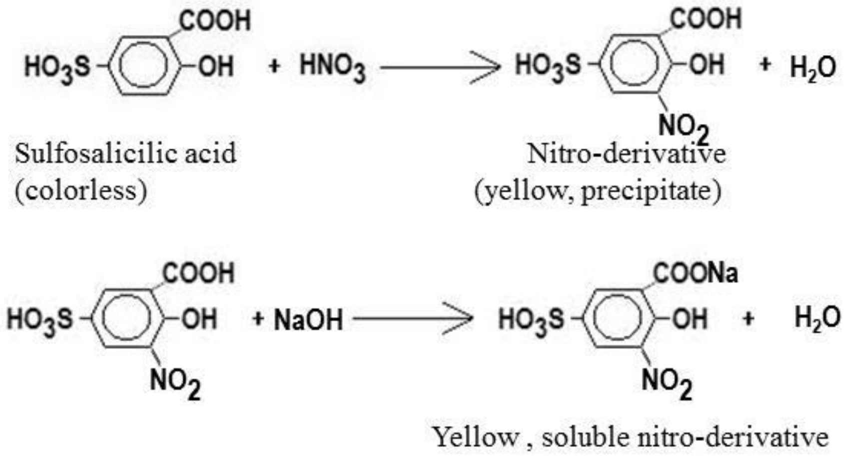
Nitrates and nitrites in food have become an increasingly discussed topic in recent years. These anions are conjugated bases of nitric acid and nitrous acid, respectively.

Their effects have been discussed over the years through the media and researched in laboratories, leading to certain conclusions about the effects of ingestion of nitrates and nitrites. The most important effect is for under 6 months old infants, the methemoglobinemia, also called "Blue Baby Syndrom" caused by cyanosis. This dysfunction consists of converting Fe^{2+} ion from hemoglobin to Fe^{3+} ion, thus changing the name of the molecule into methemoglobin. Methemoglobin is not capable of transporting oxygen so efficiently to tissues, ranging from mild cyanosis to death [1]. Other side effects have also been discovered, the most relevant of which is the increased risk of gastric cancer by degrading compounds in nitrosamines, considered to cause cancer [2].

Within the EU commissions it was decided that the maximum admitted nitrate and nitrite concentration of drinking water would be 50 mg NO_3^- and 0.5 mg NO_2^- /L, respectively, values which have been assumed by Romania, too [1]. Other member states have imposed their own thresholds, such as Great Britain (18-42 mg/L) [3] or Ireland (37.5 mg/L) [4]. Instead, the threshold for processed meat products is increased to 70 mg/kg [5].

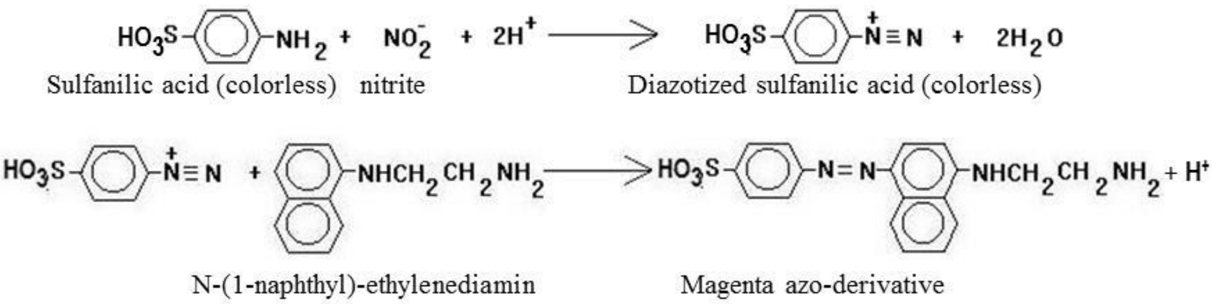
To see whether both bottled water and processed meat fall within the limits imposed by the law, we conducted two experimental activities.

For both experimental activities we used the spectrophotometric method. Spectrophotometry is a branch of molecular spectroscopy that deals with the qualitative, but mainly the quantitative analysis of inorganic or organic substances based on their UV-VIS absorption spectra [6]. For nitrate quantification in bottled waters we used the sulfosalicylic acid method using sodium salicylate and caustic soda (to generate sulfosalicylic acid), sodium azide (to eliminate nitrites interferences), the disodium salt of ethylenediamino tetraaacetic acid (EDTA) (to avoid the precipitation of Ca^{2+} and Mg^{2+} salts), and sulfuric acid [7]. After adding all reagents, the solutions assummed a yellow color and absorbance was measured at 415 nm. The reactions generating the yellow color are shown below:



After processing and analyzing all samples we concluded that the bottled still water *Dorna* has the highest amount of nitrates, namely 5.23 mg/L while *Perla Moldovei* only 0.70 mg/L.

Nitrites quantification was carried out with the aid of 4–aminobenzenesulfonamide, N–(1–naphthyl) ethylene diamine dihydrochloride and orthophosphoric acid; they imparted a magenta color to the water sample. We measured absorbance spectrophotometrically at the wavelength of 540 nm [7, 8]. The development of the magenta color in the analyzed water and meat samples is based on the reactions listed below:



After comparing results, we concluded that *Aqua Carpatica* has the lowest amount of nitrite, namely 6.7 μg/L and *Devin* has the highest amount, namely 60.7 μg/L. We used the color reagent mentioned for the water analysis, along with potassium ferricyanide trihydrate, zinc acetate dihydrate, and saturated borax solution for analysing the nitrites in processed meat [10]. The analyzed samples assumed the same magenta color, whose absorbance we measured spectrophotometrically at 540 nm. In the end we concluded that the lowest level of nitrites was present in the *Traditional baloney* respectively 12.44 mg/kg, and the largest amount was found in the *Victoria salami* (38.97 mg/kg) respectively.

After carrying out this project, we concluded that nitrite and nitrate anions have a visible effect on the functioning of the human body, and although there is an amount of these chemical compounds given on the label, lower than the reality or even zero to attract more buyers, the values are kept within the limits imposed by the current legislation.

References

1. https://cnmrmc.insp.gov.ro/cnmrmc/images/ghiduri/Ghid-Apa-De-Fantana.pdf
2. P. Song, L. Wu, W. Guan, Dietary Nitrates, Nitrites, and Nitrosamines Intake and the Risk of Gastric Cancer: A Meta-Analysis, Nutrients. 2015; 7(12): 9872–9895.
3. https://evz.ro/apa-imbuteliata-pericol-pentru-nou-nascuti-vezi-ce-cantitate-de-nitrati-contine-o-sticla-de.html
4. https://www.epa.ie/pubs/reports/water/waterqua/waterrep/Chapter%205%20Groundwater.pdf
5. http://proalimente.com/contaminarea-produselor-din-carne-cu-nitrati-si-nitriti/
6. http://www.rasfoiesc.com/educatie/fizica/Spectrofotometria-fotometria-s37.php
7. http://89.34.160.17/ibest/module/calitatea_apei/pages/nit.php
8. https://www.researchgate.net/profile/Adrian_Burada2/publication/294694361_METODE_DE_MONITORIZARE_A_INDICATORILOR_FIZICOCHIMICI_IN_ECOSISTEMELE_ACVATICE_ALE_DELTEI_DUNARII/links/56c2fd7e08aee3dcd41632af/METODE-DE-MONITORIZARE-A-INDICATORILOR-FIZICOCHIMICI-IN-ECOSISTEMELE-ACVATICE-ALE-DELTEI-DUNARII.pdf
9. http://www.ecs.umass.edu/cee/reckhow/courses/572/572bk17/572BK17.html
10. http://www.umfiasi.ro/ScoalaDoctorala/TezeDoctorat/Teze%20Doctorat/Rezumat%20DIACONU%20(AVASILC%C4%82I)%20LILIANA.pdf

*The authors of this work received the I[st] Prize at the National Competition" CHEMISTRY-Friend or enemy?!" 2018

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JOKES

☺ „Sometimes I replicate so good that I dream that Shakespeare comes to me and apologizes for writing them before ....„
[https://antoneseiliviu.wordpress.com/2016/10/09/bancuri-de-week-end-6-bune-cu-skepsys/]

IDENTIFYING CALCIUM IN BONES

<u>The aim of the experiment:</u> Mammalian bones contain calcium. Identifying the calcium in the bones demonstrates the importance of eating calcium-rich food.

<u>Materials used:</u> bone powder, 15% HCl solution, 15% H_2SO_4 solution, mortar and pestle, 3 Erlenmeyer flasks, funnel, filter paper, pipette, glass slides, microscope.

<u>Experimental steps</u>: The bone powder is obtained by calcination and grinding of mammalian bones (Figure 1). A pinch of bone powder is added in an Erlenmeyer flask, a small volume of 15% HCl solution is added to disolve the mineral salts (Figure 2) and the suspension is filtered (Figure 3). 100 mL H_2SO_4, 15% solution, is added into the filtrate, mixed, and left a few minutes to rest. A small volume of the filtrate is pippetted on a glass slide. The slide is covered and observed at a microscope.

Fig. 1. Mammalian bone

Fig. 2. Bone powder and reagents

Fig. 3. Filtration of the dissolved bone sample

<u>Results:</u> By mixing the bones a brownish powder was obtained. Upon addition of 15% HCl solution, a small amount of bone powder is dissolved. Filtration resulted in a white-yellow filtrate which became turbid after adding the 15% H_2SO solution,

Different types of crystals can be seen using a microscope: acicular crystals, prismatic crystals (Figure 4).

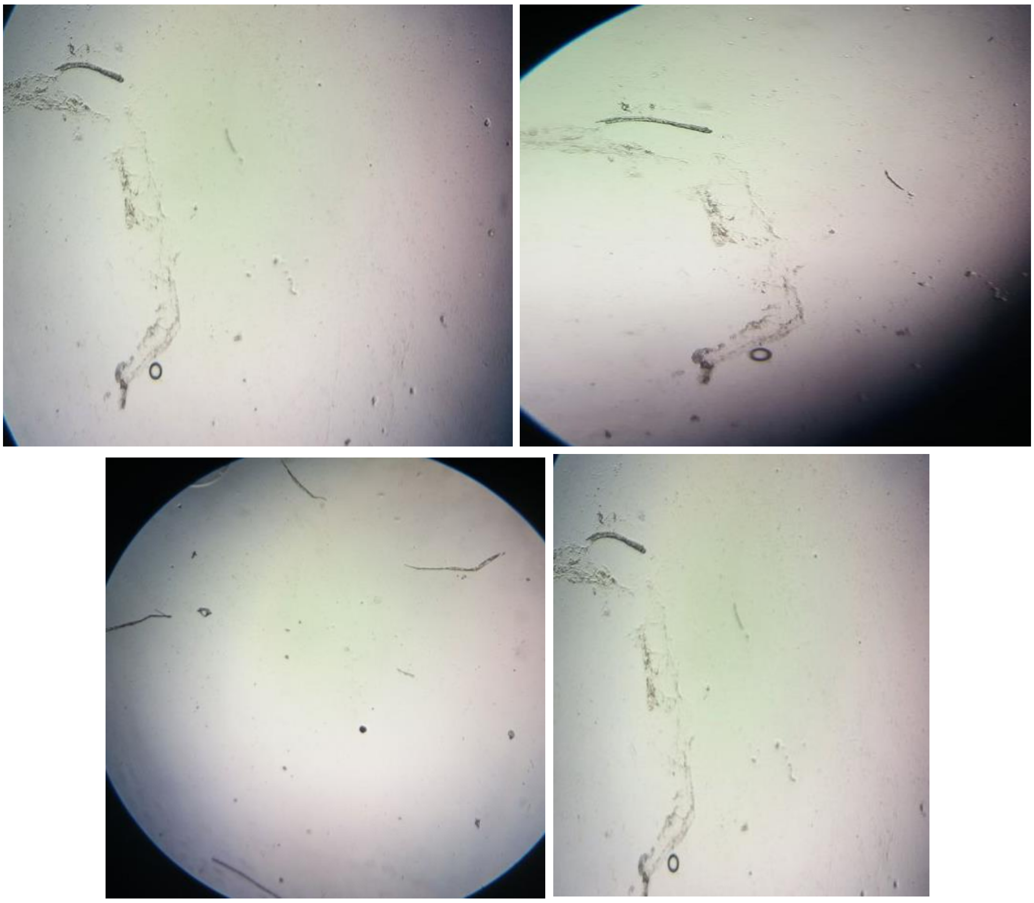

Fig. 4. Cristals observed at the microscope

<u>Explanation of the observed phenomena</u>: The HCl solution dissolved the calcium salts (phosphates, fluoride, bicarbonate) found in the bones. H_2SO_4 solution precipitated the calcium sulphate, observed under the microscope as acicular crystals.

References

T. Șăitan, M. Gros, A. S. Popescu, C. Gurzu, Lucrări practice de biologie, Gimnaziu și liceu, Didactica Publishing House, 2010.

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STUDENTS' CHEMISTRY

THE FULLERENES

Fullerenes represent the third allotropic form of carbon (along with graphite and diamond (Figure 1). They have either spherical (geodesic dome type: C_{60}, C_{540}) or cylindrical forms (nanotubes, discovered in 1991 by the Japanese Iijima Sumio).

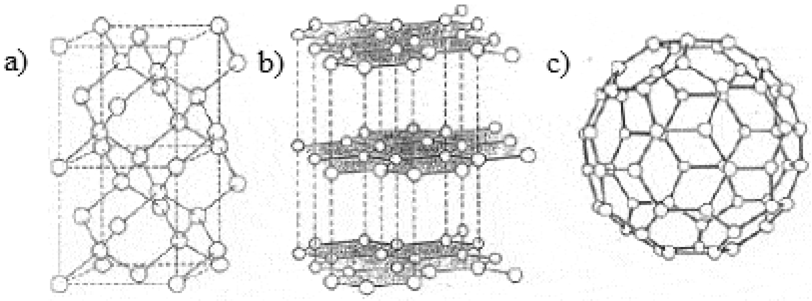

Fig. 1. The three allotropic forms of carbon: a) diamond, b) graphite and c) fullerene [1].

Fullerenes were discovered in 1985 by Sir Harold W Kroto (UK), Richard E. Smalley and Robert F. Curl Jr. (USA). They were awarded the Nobel Prize for Chemistry in 1996 for this achievement. The name was given after the American architect Richard Buckminster Fuller, the developer of the geodesic dome (in the 1960'), because his ideas inspired the above mentioned researchers in imaging the structure of these compounds [1,2].

The first paper related to fullerenes appeared in 1985 in "Nature" [3] and in 1991 fullerene became the Molecule of the Year because it attracted the most scientific interest; the average publication rate on this topic was a paper every 13 hours in the first years after their discovery. Fullerenes exist in the nature and in the interstellar space (e.g. meteorites) [2, 4].

The principal representative of this class of compounds is the C_{60} fullerene, with the shape of a modern soccer ball, having 60 carbon atoms joined together by simple (in pentagons) and double (in hexagons) bonds forming a polyhedron with 12 pentagonal and 30 hexagonal faces. The ratio of the fullerene molecule dimensions and of a soccer ball is similar to that between Earth and a soccer ball. The diameter of Earth, soccer ball and fullerene C_{60} molecule is 12.75×10^{6} m, 2.2×10^{-1} m and 7.0×10^{-10} m, respectively [4].

After 1990, when Wolfgang Krätschmer from the Max Planck Institute fur Nuclear Physics, Heidelberg, Germany and Donald Huffman from the Arizona University, SUA, developed a simple method for obtaining fullerenes by applying an electrical discharge between two graphite rods in helium atmosphere, fullerenes have been produced at macroscopic scale [2].

The fullerene structure gives them the following physical properties:

- solid substances,
- stable and resistant at high temperatures and pressures,

- ⇨ have a dark (black) colour and a high opacity,
- ⇨ present reduced hardness,
- ⇨ good electrical and thermal conductors; by incorporating alkaline and alkaline-earth metals in the structure of the crystalline C_{60} compounds they become superconductors at temperatures above 19 K,
- ⇨ soluble in benzene, toluene, and chloroform [2].

Fullerenes (especially C_{60} behaves like an electron deficient alkene, but sometimes it can behave also like an aromatic compound [5]) can participate in different reactions: laser decomposition (leads to compound restriction up to C_{32}), redox (with possible applications in electronics [1, 2]), free radicals scavenging (having thus a protective role against cells damage, with possible biomedical applications, Figure 2 [4]), additions (Figure 3) [3, 4], halogenations (substitution reaction leading to the modification of fullerenes properties, e.g. dissolution, reduction in the electronic delocalisation and aromaticity of the fullerene C_{60}, bromination results in fullerene's color change), whereas halide substitution with other moieties (e.g. phenyl) leads to new fullerene derivatives [1-3].

It was also shown that fullerenes are nanomaterials biocompatible with biomolecules and C_{60} can generate oxygen species when irradiated with visible radiation, being thus adequate for photodynamic therapy (PDT) [4].

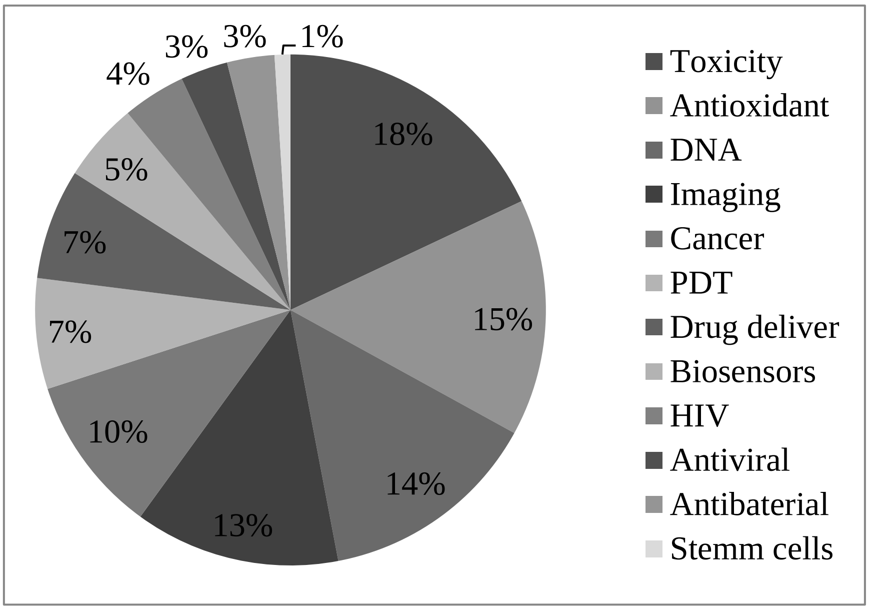

Fig. 2. The distribution of fullerene's biomedical applications [4]

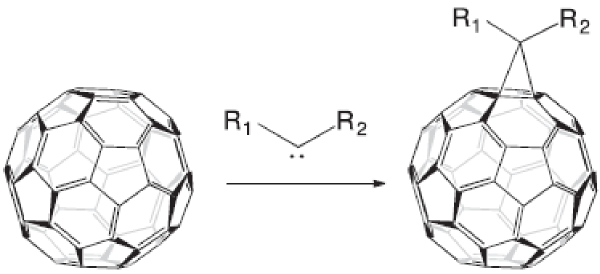

Fig. 3. Cycloaddition reaction to fullerene [4]

The fullerene structure can be determined by the following application.

Giving that the C_{60} molecule contains 20 hexagons and p pentagons, find the value of p [6].

<u>Solution</u>

We note: m = number of edges; f = number of faces; p = number of pentagons; v = number of vertices = number of atoms = 60; h = number of hexagons = 20

Each face is either a pentagon or a hexagon => $f = p + h$ (1)

Each edge has 2 vertices; each vertex is the intersection of 3 edges (because the faces have more than 3 edges) => $3 \times v = 2 \times m$ (2)

=> $m = 3 \times v / 2$ (3)

Euler' formula applies: $v + f – m = 2$ (4)

Considering equations (1) and (3) => $v + (p + h) – 3 \times v / 2 = 2$ (5)

And replacing in equation (5) the known values => $60 + (p + 20) – 3 \times 60 / 2 = 2$

=> $p – 10 = 2$ => $p = 12$

<u>Exercise:</u> *Considering the previous example calculate the number of hexagons and the number of pentagons in fullerene C_{70}.*

The solution will be published in CHIMIA-Journal for Students- Nr.5/2019-New Edition.

References

1. http://nano-c.com/technology-platform/what-is-a-fullerene/
2. https://www.britannica.com/science/fullerene
3. http://www.rasfoiesc.com/educatie/chimie/Proprietati-Chimice-ale-Fulere46.php
4. https://www.sciencedirect.com/science/article/pii/S1369702116301808
5. http://www.ch.ic.ac.uk/local/projects/unwin/Fullerenes.html
6. https://www.techtud.com/doubt/find-number-pentagonal-faces-given-fullerene

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ROMANIA AT INTERNATIONAL CHEMISTRY AND SCIENCE OLYMPIADS IN 2018

Since its first edition in 1968, the International Chemistry Olympiad (IChO) has become a very big event, held annually in a different place around the world, requiring enormous human and logistic resources. This year, the Olympiad had its 50th anniversary and to honour this, it took place in Slovakia and Czech Republic, under the motto "Back to where it all began" [1]. Just to highlight the size of the event celebrating each year young and passionate chemists there are a few details to present: while the first edition hosted by Czechoslovakia in Prague lasted four days, having three students teams (Czechoslovakia, Poland, Hungary), and required to solve 4 theoretical and 2 practical tasks in the native language, in 4 hours span time [2], this year event hosted 300 students from 82 countries going through two challenging 5 hour exams (theoretical and practical), summing up 11 tasks. The costs of the Olympiad raised to around 2 million €, involving the acquisition of more than 50,000 pieces of lab glassware, 4,000 pipettes, 2,400 beakers, ca. 150,000 sheets of paper, 800 pencils, 320 stirrer hotplates, fume hoods, work benches etc. [3].

The practical exam was held in Bratislava, at Comenius University and the theoretical exam was held in Prague, at University of Chemistry and Technology, on July 19th–29th, 2018. A large number of staff was required to organise such a big event, for theoretical, but especially for the practical exam (250 people) [3, 4]. The author's team was composed of university and preuniversity levels 30 teachers. The preparations for the Olympiad started two years prior the event. The proposed topics were related to the two countries history, culture, and geography, covering fields of organic, inorganic, analitycal, physical chemistry and biochemistry. The authors told that drafting the tasks was very challenging and sometimes there were more than 20 versions between the initial and final proposed task.

Romania has participated to the IChO since 1970, gathering up to now approximately 150 medals (out of which 30 were gold medals) and held two times IChO, in 1974 (Bucharest) and 1983 (Timișoara). Most medalists took careers in chemistry or medicine, as researchers, university/pre-university school teachers or medical doctors, at home or abroad, at famous universities, research institutes or hospitals. All these results could not have been possible without dedicated chemistry teachers around all country, who selected and shared their knowledge with passionate students, working hours and hours to decipher tricky and complex problems to compete in the National Chemistry Olympiad. The selection and preparation for the International Chemistry Olympiad is the tasks of university teachers from five Romanian Universities, covering all fields of chemistry that are annually announced as topics.

In 2018, our team, led by Acad. Marius Andruh won three silver medals and one bronze medal (from left to right in Figure 1):

CHEMISTRY Competitions/Activities /Events

Tudor Cristian Cozma - National College „Emil Racoviță” Iași - **silver medal,** *prof. Paula Gavrilescu;*

Daniel Cristian Ungureanu - International Computer High School of Bucharest - **bronze medal,** *prof. Lina Chiru*;

Teodora Stan - International Computer High School of Bucharest - **silver medal,** *prof. Lina Chiru,*

Hakan Calila - National College „Mircea cel Bătrân” Constanţa - **silver medal,** *prof. Doina Bălașa* [5].

Fig.1. Pupils composing team of Romania after closing ceremony

Besides the exams, the students had a social and cultural programme, which allowed interaction with students around the world, sharing experiences and exchanging ideas during several days, thus making this event unique and hunted by hundreds of children for the fabulous summer week of the international contest.

Fig. 2. Team members in their free time - source: the offcial photo galley of the IChO 2018

The Mendeleev International Chemistry Olympiad (MIChO) is an important international contest, with very complex and difficult tasks, held annually in April-May, prior to IChO. The Olympiad is organised by Moscow State University and initially the participating countries were mainly from the ex-soviet area. Nowadays, MIChO, also a big event, has grown to 22 countries, approximately 130 children competing during one week in three 5 hours difficult exams: two theoretical and one practical [6]. A standard team is composed of four children. However, due to extraordinary results the Romanian team had in recent years, since 2010 the organisers invited and allowed a team of six students. They are currently selected at the National Chemistry Olympiad, as first six in the selection exam for

for the national extended team (20 pupils).

Romania has participated to MIChO since 2004 at the initiative of the General Inspector in the Ministry of National Education, Prof. Daniela Bogdan, and got three times the absolute gold (in 2014 - Andreea Maria Filip, 2015 - Dumitru Călugăru, and 2016 - Andrei Iliescu). We could not be present in MIChO in 2012 and 2017, due to the national contest calendar held too late to allow the selection of the team. A total of 15 gold medals, 27 silver medals and 24 bronze medals represent the record of our teams in 13 years of MIChO.

Team of Romania returned from the 52nd edition of MIChO (April 22nd - 28th 2018) held in Minsk, Repulic of Belarus with five medals: one gold and four silver medals (from left to right in Figure 3):

Fig. 3 Team of Romania at MIChO 2018

Tudor Cristian Cozma - National College „Emil Racoviță" Iași - **gold medal,** *prof. Paula Gavrilescu;*

Miruna Belciu - National College „Gheorghe Vrănceanu" Bacău, participant, *prof. Mariana Rosenschein*;

Gabriela Diana Oprea - National College „B. P. Hasdeu" Buzău - **silver medal,** *prof. Viviana Gaitanovici*, *prof. Carmen Gheorghe;*

Andrei Vald Bădulescu - National College **„**Emanuil Gojdu" Oradea - **silver medal**, *prof. Anița Luncan;*

Hakan Calila - National College „Mircea cel Bătrân" Constanţa - **silver medal**, *prof. Doina Bălașa;*

Daniel Cristian Ungureanu - International Computer High School of Bucharest - **silver medal,** *prof. Lina Chiru.*

The 25th edition of the **International Tuymaada Olympiad in Mathematics, Physics, Chemistry and Informatics** [7] took place within the Yakutia International Science Games 2018, on 8th - 15th July 2018. This is well known as the multidisciplinary olympiad of the Northern Russia. The chemistry contest hosted 26 participants. The Romanian students were ranked in the first half, as it follows:

Ana Florescu Ciobotaru - International Computer High School of Bucharest – **absolute gold medal***;*

Miruna Maria Constantinescu - National College „Sfântul Sava" Bucharest - **gold medal**;

Miruna-Ioana Belciu - National College „Gheorghe Vrânceanu" Bacău - **silver medal.**

The European Union Science Olympiad (EUSO) is an international competition in which each member state participates with two teams of students, each team having to complete chemistry, biology, and physics experiments. Romania has participated to EUSO since 2010, currently having very good results. In 2018, EUSO was held on 28th April-5th May, in **Ljubljana (Slovenia)** and **Romania won two silver medals** [8]**:**

Team A: **Răzvan**- A**drian Covache-Busuioc** - National College „Alexandru Ioan Cuza" Alexandria – biology,
Teodora Stan - International Computer High School of Bucharest – chemistry,
Vasile Mihai - International Computer High School of Bucharest – physics;

Team B: **Irina Maria Palaghia** - National Military College „Tudor Vladimirescu" Craiova – biology,
Antonia-Georgiana Zavate - National College „Gh. Roșca Codreanu" Bârlad – chemistry,
Ariana-Dalia Vlad - International Computer High School of Bucharest - physics.

The medals earned by the Romanian students in 2018 come as a consequence of the results obtained in previous Olympiads, as well as the individual and institutional training efforts. The medal balance (still!) reflects passion and interest of the young chemists and their teachers! It is our duty to convince at least a part of these participants to stay or come back from abroad, in order to ensure the future of the Romanian chemistry, as well as to defend our top positions within the International Chemistry Olympiads rankings!

References:

1. https://50icho.eu/
2. https://www.iuventa.sk
3. K. Meyer, Behind the Scenes at the 50th International Chemistry Olympiad, *ChemistryViews Magazine*, Wiley-VCH Verlag GmbH & Co. KGaA, 2018, DOI: 10.1002/chemv.201800082
4. K. Meyer, P. Ménová, O. Šimůnek, E. Szabó, Authoring Olympiad-Level Chemistry Exams, *ChemistryViews Magazine*, Wiley-VCH Verlag GmbH & Co. KGaA, 2018, DOI: 10.1002/chemv.201800096.
5. https://50icho.eu/icho-2018/medal-results/
6. http://www.imo52.chemistry.bsu.by/results.pdf
7. http://yisg.ru/event/2#
8. https://www.euso2018.si/home/

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University of Bucharest, Faculty of Chemistry
Prof. Daniela BOGDAN,
National College „Sfântul Sava" Bucharest
Lect. dr. Mihaela MATACHE,
University of Bucharest, Faculty of Chemistry

CHEMISTRY Competitions/Activities /Events

THE FIRST MEETING WITH THE SUCCESS

A competition can bring a passion for life, it may be the first step towards a brilliant career. What is the *Raluca Ripan* Chemistry Competition[1]? It is the competition for the youngest chemists of Romania, the competition with the greatest emotional load, the competition that impresses you, through the creativity and spontaneity of some children, through the passion and seriousness with which they "play" with test tubes and reagents, through the inspiration with which they approach the samples which sometimes can be difficult even for adults.

This year, our hosts: ISJ Bucharest, University *Politehnica* of Bucharest and, last but not least, the *Iuliu Maniu* Technical College Bucharest were exceptional organizers who made this event an unforgettable memory for all participants. There have been many days of work, days of emotions, tensions, trials, for all those involved in this contest.

It was for me, a special experience, I met beautiful people, true professionals, I felt passion and dedication on behalf of everyone: organizers, committee, accompanying teachers and especially children, eager to compete, to change ideas, to bind friendships.

I congratulate the students and their teachers for their teamwork, the parents and the family supporting them, for the desire to improve their knowledge, to acquire practical skills, to compete, regardless the outcome, as participation in a national competition is an honor itself.

I wish everyone a great success for performance and excellence in chemistry!

Prof. dr. Carmen-Gina Ciobîcă
ISJ Suceava

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CHEMISTRY Competitions/Activities /Events

THE NATIONAL SCIENCES OLYMPIAD FOR JUNIORS FOCȘANI, 22-26 JULY 2018

Have you ever wondered where the tradition of Olympiads, with which generations of students are facing every year, comes from? Well, right in ancient Greece! At that time, the Olympics took place in the city of Olympia, in honor of Zeus, the emperor of the gods. The best athletes attended the Olympics and were supported by the city through hard training lasting at least ten months prior participation. The games lasted for five days and began solemnly, with the solemn parade of the competitors and the Olympic oath. The winners were celebrated on the last day of the games when they received the most coveted trophy of the ancient world, the laurel wreath.

In July 2018, Olympia of ancient Greece moved to Focsani, Vrancea County, where 105 of the best students from 33 counties of Romania came together to duel in knowledge and skills in science.

The opening of the competition took place in the hall of the National College "Unirea" of Focsani, the host of the whole event for five days. The guests have watched a film about the history of the college and the town of Focsani, after which they received the greetings of the County School Inspectorate and the local authorities. In order to strengthen the importance of the National College "Unirea" in the history of Romanian education and to give weight to the event, the director of the Unirea National College, Professor Cornel Noană, recalled three names of Romanian academics, former students of the host unit of this year's Olympics: academics Anghel Saligny, Gheorghe Longinescu, and Oscar Sager - follower of Gheorghe Marinescu, founder of the Romanian School of Neurology. "You are the ones who will take care of the image of this country. The important thing is how you choose the place where you do it, whether it will be at the International Olympiad or later, whether you will be at home or abroad, I am convinced you will represent us well." said director Cornel Noană.

The Central Commission consisted of forty-five professors, president being Dr. Gabriel Pascu from the West University of Timisoara, and executive president Traian Șaitan - inspector of the Ministery of National Education (MEN). Moreover, Traian Șaitan welcomed the large number of participants in this year's edition, compared to the previous one. „I am very happy that you are more numerous than last year, and I hope that year after year the number of participants in this Olympics, which is not easy at all, will increase. I would like to thank very much to the local authorities for supporting this Olympics", said Inspector Traian Șaitan.

The competitors performed two tests, a practical and a theoretical one, which included knowledge gained in the three disciplines: physics, chemistry, and biology.

The award ceremony took place in a festive setting, the laurel wreath being given to Savin Eva Maria, from the *Mihai Viteazul* National College in Bucharest. On second place was the student Oros Vlad Ştefan, from Gimnazal School no. 24 in Timisoara, and the third place was obtained by Muntean Mara, from the *Decebal* National College in Deva. Fifteen mentions from MEN and thirty special prizes from the County School Inspectorate Vrancea and the Local Council Focsani were also awarded.

Although winners today no longer worship their feet and no statues are raised, even if the losers do not prefer to die than to admit defeat, AT THE OLYMPICS, THE MOST IMPORTANT THING IS NOT TO WIN, BUT TO PARTICIPATE, as in life it does not matter the triumph, but the struggle.

People from Vrances county have been honored to host such a high-profile intellectual competition with a high degree of professionalism, rewarding the work, perseverance and dedication of students and mentors. Chemistry attracts many talented and passionate students and makes them work to excel.

Prof. Andreea VÎRNĂ
„Alexandru Vlahuță” Secondary School, Focșani

FAMOUS QUOTES

✍ -„Success is the result of perfection, hard work, learning from failure, loyalty, and persistence.” – *Colin Powell* (American statesman)

[https://www.brainyquote.com/lists/authors/top_10_colin_powell_quotes]

CHEMISTRY Competitions/Activities /Events

UB SUMMER UNIVERSITY 2018

July, what a wonderful month! Besides the fact that the holiday was still at the beginning, perhaps the most beautiful event of the year was at its start: the summer camp organized by the students of the University of Bucharest “UBSU - UB Summer University”.

It happened on a Sunday, exactly on July 22, when 157 11th grade pupils gathered from all corners of the country were due to arrive in Bucharest. The organizers, students at the University, waited impatiently for them on the busy platforms of the North Railway Station, accompanied by various banners wishing them “Welcome!”. As they arrived, the pupils were led to Grozaveşti campus, where they lived for 10 days.

Their first day in the camp was the knowledge of the new, the place, of Bucharest and of the people who will join them during this period.

The second day was devoted to the students’ associations that have introduced the little ones in the area of volunteering and they explained what it entails and what a student organization means.

The next three days were full of laboratories and lectures, wanting to show the beauty of chemistry. On the first day, the students took part in the Inorganic Chemistry Laboratory, supervised by Lect. Dr. Delia-Laura Popescu. They continued the next day with the Physical Chemistry Laboratory, led by Lect. Dr. Adina Răducan, and with the Technological Chemistry Laboratory, under the guidance of Lect. Dr. Adriana Urdă. The course was completed with two Analytical Chemistry Laboratories, namely the "Methods of absorption and molecular emission in visible and ultraviolet" presented by Assoc. Prof. Dr. Iulia David and Assist. Dr. Dana Popa, and the second one "Analytical Chemistry Experiments - Between Analyzed, Exciting, and Relevant", passing through beautiful and spectacular, together with Lect. Dr. Adriana Gheorghe.

Laboratories and lectures were not the only attractions organized for the participants! The project organizers ensured that they offered them the most beautiful summer experience. So the participants were divided into the so-called "houses" called Fantastics, Xaolins, Galactics, Warriors, Legendaries, Titans, Guardians and Justices. Everyday fun meant that every day included different activities, such as the Folk Evening in the Grozaveşti Campus, where, gathered all in a circle and accompanied by Guitar Grozăveşti group, we sang until late in the night ("Andri Popa", but also "Crazy White" or "Vama Veche").

Probably the greatest challenge of this camp was the competition between the eight houses, which took place throughout the whole period, including a dance contest - when for one hour participants had to improvise a certain type of dance (popular, contemporary, Indian and other styles to make their creativity worthwhile), chosen at random by the house coordinators. Also, every house had to prepare an artistic moment, and the best was awarded! The Treasure hunt and "Bucharest, Nice to meet you!" had the purpose of knowing Bucharest, and the plaything, the pointers and the various evidence they had to cross had made all the fun.

Within the project we wanted to simulate real student life, therefore we took the meals at the cafeteria and the accommodation was in the hostels of the University of Bucharest, in the Grozăvești Campus.

And because any student has to pass an exam session, at the end, the participants performed a test to verify the knowledge gained during the class hours.

After 10 sleepless days when we approached people we had never seen before, we are reaching the end of the second edition of the UB-Summer University, filled with satisfaction. We create links, as we, the Chemistry Students Association of the University of Bucharest, like to say. The camp ended with tears and hugs, but especially with memories of the summer of 2018 that will not be forgotten so easily.

See you next year!

Student Patricia OPREA
Association of Chemistry Students of the University of Bucharest
Foto: *Chem. Dr. Traian PĂS*ĂTOIU
University of Bucharest, Faculty of Chemistry

CHEMISTRY Competitions/Activities /Events

THE EUROPEAN RESEARCHERS` NIGHT

The last weekend in September brings every year the already well-known event "The European Researchers` Night", where both children and adults are invited to the fascinating world of exact sciences. This happened this year, too. Numerous presentations, numerous experiments and numerous inventions could be admired and searched during two days at the University Square in Bucharest. Other similar presentations have taken place in several cities across the country.

"The European Researchers' Night" is a "Marie Curie" event aiming to show to the general public what it means to be a researcher and how interesting research can be. "The European Researchers' Night" was organized for the first time in 2005 and until this year attracted over 1.5 million visitors.

As it was already mentioned, this year "The European Researchers' Night", dedicated to science, took place in the University Square on Friday, September 28 and Saturday, September 29**.** All those interested in science attended the event and not only. Visitors have had unforgettable experiences organized by research institutes and faculties.

This year the Association of Chemistry Students of the University of Bucharest (ASC-UB) was present at the event again at the stand of the Faculty of Chemistry of the University of Bucharest, showing to the general public what chemistry, passion for chemistry means and how chemistry is everything surrounding us. During the two days with lots of colorful mysterious experiments, visitors have known aspects of chemistry or have recalled forgotten notions.

The ASC-UB had different surprises for visitors, from balloons that were amazingly swollen with carbon ice, the tube rainbow show or even a competition of "chemical culture", based on Mendeleev's table made up of biscuits. We can say that this contest was the main attraction for both the little explorers and the older participants. The chemical culture contest consisted of 3 different degrees of difficulty.

The first test challenged the competitors to recognize an element in Mendeleev's periodic table, an element that was written with colored chocolate on biscuits. If they responded correctly, the biscuit could be eaten, and the participant passed to the next tests that ranged from simple questions to some more complex.

We are happy to admit that the elements were insufficient in both days, and we had to restart the sweet pattern of the table many times because of the large number of participants.

After the two days of science, we are convinced that this year's visitors will be back again next year, and we are preparing even more spectacular surprises for them.

Student Alexandra MANEA
Association of Chemistry Students of the University of Bucharest
Foto: *Chem. Dr. Traian PĂSĂ*TOIU
University of Bucharest, Faculty of Chemistry

FAMOUS QUOTES

✍ -„ Success is not final, failure is not fatal: it is the courage to continue that counts." – *Winston Churchill* (British statesman)

✍ -„ Success consists of going from failure to failure without loss of enthusiasm." – *Winston Churchill*

✍ -„ Always be yourself, express yourself, have faith in yourself, do not go out and look for a successful personality and duplicate it." – *Bruce Lee* (American actor)

✍ -„ Try not to become a man of success, but rather try to become a man of value." – *Albert Einstein*

✍ -„ Success is a science; if you have the conditions, you get the result." – *Oscar Wilde* (Irish playwriter)

[https://www.brainyquote.com/topics/success]

THE CHEMISTRY FESTIVAL
"THERE IS CHEMISTRY BETWEEN US!"

The end of September marks an important event for students of all ages interested in the wonderful world of science, enchanted by the magic of chemistry. The Chemistry Festival „There is CHEMISTRY between us!" took place on September 28, 2018, at the Cultural Center "Petőfi Sándor" and it was organized by the American Chemical Society (ACS) and the Romanian Chapter of ACS International, represented by by Assoc. Prof. Marilena Ferbinţeanu Cimpoeşu, in collaboration with the Faculty of Chemistry, part of the University of Bucharest, which was represented by university teachers and voluntary students, as well as Playouth. The project aims to bring the games, art, and joy in studying chemistry, as well as to develop relations between universities, pre-university education institutions, scientific research institutes, laboratories and industry.

Describing a volunteer's emotions!

Being a student in the 11th grade at the Energetical Technical College, this project brought a lot of joy to me. I knew that my level of knowledges is not a very high one, but I accepted to participate at this event due to the encouragement of Mr. Iacob Voichiţoniu, one of my teachers. At the first meeting of the volunteers, organized at the Faculty of Chemistry, where Mrs. Assoc. Prof. Marilena Ferbinţeanu Cimpoeșu presented us the activities schedule, we met people of different ages (college and university students, researchers, and teachers) excited of what they were doing and happy about our presence, and so I immediately passed my initial status of loneliness. To my surprise, I managed to talk to all volunteers, students and teachers present, participating actively in all the 15 experiments proposed. Although there were experiments for children between 8 and 15 years, they were very interesting for me too. But, at the same time, we tried to be well organized and monitored carefully all events taking precautions to keep all children safe. The event organizers provided us with a nice T-shirt and a snack, welcomed at the lunch time. All children received small gifts representative for the event (backpack, UV bracelets,

periodical systems, small experimenter's notebooks, pens and balloons) which completed their joy.

My colleague Andrei Cristian Popescu and I choose the "The *Colorful Tower"*, a very nice experiment that makes the kids a little thoughtfull. Why am I saying that? Because, we formed the "*Colorful Tower"* from three different solutions colored in red, yellow and green.

In three glasses with the same water level and different colors we added different sugar quantities, this way having different densities as well. We placed the colors in a test tube, in the decreasing order of the quantity of sugar and densities, one layer on the top of the other, without mixing them. A lot of them succeeded in doing this experiment and their joy could be seen in their smiles. Their interest exceeded my expectations, as groups of children seem to never end. In the same day, I realized that such projects will help us in the future and are usefull.

Throughout the day, the three colors of the experiment allowed me to describe some of my thoughts. The experiment can also be called "*The Tower of Moods"*, red representing the state of the suffering or human depression, then the green one can be seen as the transition stage to a better state, but if the liquids are not placed carefully, by slow flowing on the tube wall, they will mix slightly giving rise to another color, this being the black one, representing a bad state, which goes through certain modifications, until it reaches in the end a state of peace and oriented towards good, yellow representing the last stage: the joy. I managed to associate this also with the children's emotions. Red represented their curiosity in small measures, green their multiplying interest and yellow their amazement or even the joy of successfully completing the scientific experiment.

Student: Maria Adriana RADU
Coordinating teacher: Iacob VOICHIȚONIU
Energetic Technical College, Bucharest
Foto: BSc student Iulian GRIGORAȘ

A DIFFERENT KIND OF SUCCESS!

The first thing I ever read about *The Junior Academy* was a Facebook ad, promoting it as "A community of exceptional students solving the world's greatest challenges". The second thing I found out about it was that it was an international STEM (Science Technology Engineering and Math) program. I applied for the program in 2017 and a little bit over a year later it's made a bigger impact on my life than over 11 years of school.

The whole program has two tasks: creating a virtual community of STEM students from all around the world and having them solve 'challenges'. The challenge system is pretty simple: every spring and autumn, the Academy launches a set of challenges, for which Junior Academy students have to propose solutions. The challenges are real life problems, such as wildfires, pollution, the need for sustainable buildings and transportation, and so much more.

When I first read about the challenges, I didn't put much thought into the 'team' aspect of it, but after working on two of them, I've come to realize that it's the most important part. Teams aren't assigned, so it's up to students to form their own, and I've seen everything from people working on their own, to teams made from groups of friends to people launching application forms to fill in the places in their teams. As far as my experience goes, the majority of both my teams were people whom I've met on Facebook and WhatsApp groups dedicated to Academy students (and whom, to this day, I've grown to call 'friends').

Working on challenges is a mix of determination, confusion and a lot of compromises when it comes to time zones and Skype calls, but there's no better feeling than knowing you came up with a good solution. After working for 60 days in Fall 2017 on the UTC Future of Buildings and Cities with 5 other students from Romania, India, Nepal, Bangladesh and Norway and submitting a final design for a sustainable building, I had learnt a lot about engineering and sustainability, but also about team work and compromises. It was the first time I had encountered some areas of science, engineering, architecture, and even geography and economics. And for the first time I learned how to combine my chemistry and biology knowledge, proving to myself once again that they are closely related. During the challenge the Academy assigned a member to each team, in order to help and bring in some expert knowledge.

In Spring 2018 I joined another team, working on the Human versus Wildlife challenge, aimed at minimizing the negative impact human activities have on ecosystems. Our team worked on a prototype for an anti-poaching device, which was later named as one of the two finalist projects of the challenge. While working on the Human versus Wildlife challenge, I had also learnt that my team had won the UTC Future of Buildings and Cities contest and we were awarded trips to the UTC Center for Intelligent Buildings in West Palm, FL, the Global STEM Alliance Summit in New York City, NY as well as a prize in money.

The Summit and UTC facilities tour were everything they were branded to be, and more. At the UTC facilities in West Palm and NYC we got to speak with experts in the green building industry, we presented them our project and gave interviews to local press, as well as toured the UTC buildings.

The GSA Summit was an opportunity for us to meet other Junior Academy students, as well as students from other New York Academy of Sciences programs, such as 1000 Girls 1000 Futures and STEM U. Apart from making new friends, exploring NYC with them and participating in fun and interesting workshops at the Summit, we got to see presentations from amazing people in the STEM field and participate in an award ceremony, held for challenge winners and distinguished students from the other programs. It was not only about fun and games, as me and a group of other Junior Academy students, with whom I am working on a separate project got to meet face to face and share ideas. The project is named Allerticon (and can be found at allerticon.com) and it is aimed at raising awareness about food allergies, helping people who have them and trying to make allergen warnings more visible on food packaging.

Again, the perfect combination between chemistry and biology allows me to understand the causes of food allergies, chemical mechanisms that lead to certain reactions, and ways of avoiding or treating more serious cases.

Over all, The Junior Academy and the GSA Summit have been about science and opportunities, as well as friends and having fun, and it's weird to think that everything could have just not happened, had I not clicked on that Facebook ad.

Ioana-Elena TĂRĂBĂŞANU-MIHĂILĂ
"Sfântul Sava" National College, Bucharest

FAMOUS QUOTES

✍ -„One of the most important things as a scientist is that you have to be an optimist. If you're a pessimist a failed experiment will tell you that this whole idea is bad, and you'll quit. Pessimists should work in insurance broking where you only look for the downside!" – *Richard Henderson* (2017's Chemistry Nobel Laureate)
[http://www.pictameni.com/instagram/dreamnobelle]

✍ -„ A dream doesn't become reality through magic; it takes sweat, determination and hard work." – *Colin Powell* (American statesman)
[https://www.brainyquote.com/lists/authors/top_10_colin_powell_quotes]