

## PART 1

### POSITIVE EFFECTS OF C<sub>60</sub>/OO ACTION ARE CAUSED BY FORMATION IN AN ORGANISM OF HYDRATED C<sub>60</sub> FULLERENE - C<sub>60</sub>HyFn

(Report of GVA on surprises that the hydrated c<sub>60</sub> fullerene presents and that it may present in the future)

To our colleagues, friends and experts at [LONGECITY](#) → [Science & Technology](#) → [Nanotechnology](#) → [C60health](#) (<http://www.longevity.org/forum/forum/415-c60health/> and others (in science and life) to whom it may concern!

Upon analysing a great number of messages that have been left to date by members of the LONGECITY forum, I would like to share my conclusions with you and, at this time, draw a kind of bottom line (to dot all the it's, so to speak) in order to inform you of the main cause of the biological effects you have discovered when using C<sub>60</sub> solutions in different (!!!) samples of olive oil = C<sub>60</sub>/OO (and in experiments conducted on yourself, on domestic animals and on poultry).

For that purpose I want to present you my short analysis of several key points, as described in the two articles discussed here.

The first article being quoted in this forum (<http://extremelongevity.net/wp-content/uploads/C60-Fullerene.pdf>) is, of course, the article by Baati et al. (under research director F. Moussa, Université Paris Sud XI) "PROLONGATION OF RATS' LIFESPAN THROUGH THE REPEATED ORAL ADMINISTRATION OF [60]FULLERENE" *Biomaterials*, 33(26), 2012b, 6292-6294.

The authors of the second article, which was published almost at the same time as Baati's article, are Japanese researchers whose article is freely accessible so that everyone can familiarise themselves with it: Kato T.M., et al. "SUB-ACUTE ORAL TOXICITY STUDY WITH FULLERENE C60 IN RATS." *J. Toxicol. Sci.*, 37(2), 2012, 353-61 (<http://dx.doi.org/10.2131/jts.37.353>).

Firstly, let me note that the works of the French and Japanese researchers were performed in accordance with requirements of international practice and standards for bioactive compound testing (surely, with due consideration of national peculiarities, e.g. the EU or JP). In other words, these works reasonably claim to be the official documents of biological testing of fullerene C60 rather than the result of some privately conducted market research. I am grateful to all of them!

So what are the similarities and what are the differences in the results obtained by the French and Japanese researchers?

1. All of them studied the biological activity of C<sub>60</sub> in the form of oily solutions: in the first case – of olive oil (with effects observed), in the second case – of corn oil (no effects observed). And what is most important here, regardless of the type of oil used, is that no hazardous or toxicological effects of C<sub>60</sub> were observed!

2. The French researchers tested C<sub>60</sub> dissolved in olive oil (C<sub>60</sub>/OO). They have actually carried out 3 independent experiments, in which they studied: (i) the distribution and bioavailability of C<sub>60</sub>, (ii) its antioxidant and hepatoprotective properties and (iii) its effect in terms of any increase in a rat's life span.

In the experiments mentioned, doses of  $C_{60}$  varied within a range of 1.7 – 4.0 mg/kg of the animal's body weight, depending upon the certain experimental design. But what is important to us is that one of the experiments revealed that, of all the total dose of  $C_{60}$  fed to rats, only its inessential part was absorbed in the gastrointestinal tract (GIT) and distributed in the other organs of the rats' organism (see below).

3. In the research carried out by the Japanese researchers, the rats were fed with fullerene  $C_{60}$  (dissolved in corn oil, CO -  $C_{60}/CO$ ) in doses of up to 1000 mg/kg of the rats' weight, which is almost one hundred times as much as the doses involved in the French experiments (!!!). They revealed an important fact, proving that  $C_{60}$  is not absorbed in the gastrointestinal tract (GIT) and, therefore, cannot be detected in other organs of the rats' organism: upon absorption, all the  $C_{60}$  remained as an amorphous mass on the stomach and intestine walls (!!!) and fullerene  $C_{60}$  itself failed to show any obvious effects in terms of biological effects.

It is worth mentioning that the chemical nature of the saturated and unsaturated fatty acids forming part of the lipids (fats) of corn and olive oils is actually identical.

But what is the difference between these two types of oil? And are biological effects of  $C_{60}/OO$  related with the OO lipids in the case that no such cases were reported in experiments with  $C_{60}/CO$ ,

In order to shed light on these questions, let's look at the components of OO (e.g. see the link <http://www.oliveoilsource.com/page/chemical-characteristics> or the Wikipedia link [http://en.wikipedia.org/wiki/Olive\\_oil](http://en.wikipedia.org/wiki/Olive_oil)) and consider the CO components ([http://en.wikipedia.org/wiki/Corn\\_oil](http://en.wikipedia.org/wiki/Corn_oil)).

As we can see from the above source information, as opposed to the CO, the OO contains chlorophylls (HPh = derivatives of porphyrins whose simplest analogues are phthalocyanines). Chlorophylls are natural plant pigments. For example, they determine the green colour and its gradations in the leaves of various plants, including ripe olive fruits and olive leaves. As a result, the deeper (and darker) the green colour is of OO, the more chlorophyll it contains.

Moreover, OO contains polar polyphenol compounds (Polyphenols, PPh), which, in addition to porphyrins (chlorophylls), are absent in other popular edible oil grades, including CO.

Nevertheless, different OO samples contain at least twice as much water as CO and other oils derived through extraction with organic solvents but not through the mere pressing of oil-containing raw, as is normally done when making OO.

But why is so much attention paid to chlorophyll? The thing is that, like phthalocyanines and porphyrins, HPh can form so-called donor-acceptor complexes (DA-complexes) with  $C_{60}$ , which are also scientifically known as charge-transfer complexes or CT-complexes (see Cataldo's chapter 13, page 331-332 on <http://www.owndoc.com/pdf/solubility-of-fullerenes-in-oil.pdf>, which were posted by Turnbuckle 09/27/2012, 12:31 PM, #67 and we can see on [http://www.longecity.org/forum/topic/57849-equipment-mixing-centrifuging-and-filtering/page\\_st\\_60](http://www.longecity.org/forum/topic/57849-equipment-mixing-centrifuging-and-filtering/page_st_60)).

Similar DA-complexes are denoted by the general formula:  $D^{(\delta^+)A^{(\delta^-)}}$ , where A is the acceptor molecule which "accepts" part of the negative charge of the charge cloud of the donor molecule D as the DA forms. In our case, A is the  $C_{60}$  molecule and D is the chlorophyll molecule, while DA-complexes (HPh/ $C_{60}$ ), consisting of a  $C_{60}$  molecule and molecules analogous to HPh, have been long known and studied in detail. To date, they are considered to be important as prospective materials, for example, for transforming solar energy into electrical energy. See examples of scientific research on DA-complexes  $C_{60}$  with porphyrins/phthalocyanines and some of their properties at <http://www.ncbi.nlm.nih.gov/pubmed/22938243> and <http://www.ncbi.nlm.nih.gov/pubmed/23050927>.

Which features of the DA-complexes HPh/ $C_{60}$  shall be interesting for further discussion here?

1. Time and again, it has already been noted by members of this forum, and shown by several C<sub>60</sub>/OO producers, that an oily solution forms when the black powder of C<sub>60</sub> dissolves in greenish OO, which, in due course, tinctures with reddish, reddish-brown or similar hues. Some examples are available at the following links:

<http://c60antiaging.com/c60-faq/the-color-of-the-carbon-60-in-olive-oil>

<http://www.longecity.org/forum/topic/58922-log-andey>

<http://www.longecity.org/forum/forum/415-c60health>

2. It is a scientifically known fact that such reddish, reddish-brown or similar hues are common for a wide range of solutions of DA-complexes of C<sub>60</sub> with other organic nitrogen- or oxygen-containing compounds, including water. Particular examples can be found at the links below:

<http://en.wikipedia.org/wiki/Buckminsterfullerene>

<http://www.ipacom.com/index.php/en/publications-about-c60hyfn/92>

It is necessary to note that, unlike hydrated C<sub>60</sub> solutions (C<sub>60</sub>HyFn, <http://www.longecity.org/forum/topic/57382-hydrated-fullerene-hyfn>), many DA-complexes of C<sub>60</sub> may be formed with organic molecules, which can remain stable only in non-aqueous media (e.g. in the medium of low-polarity organic solvents, to which OO, CO, FO (fish oils) etc. may be referred).

3. Here I would like to mention one important point as a common example. The point is that the DA-complex, which is formed with two “hydrophobic” molecules (that “feel themselves convenient” in oily medium) due to the separation of electrical +/- charges therein, acquires the properties of a polar, hydrophilic chemical compound (composite). Such a complex is bad in terms of getting along with a hydrophobic oily medium. As a result, having formed in an oily medium, the complex will seek to leave it, to separate from it and form its own combination community (phase) of molecules with similar properties, which would be separate from oil. Scientifically this phenomenon is characterised as the transformation of homogeneous system into a heterogeneous one, which is one consisting of several separate molecular communities-phases.

Several enthusiasts of our forum witnessed visual proof of this process. As they noticed, during the cooling/freezing of C<sub>60</sub>/OO and depending on the grade and quality of OO, a rather clear layering of C<sub>60</sub>/OO into two phases (layers), can be observed: the main phase (in weight) has a hue similar to that of the initial OO and there is a separate solution layer of reddish-brown hue similar to that of the solutions of the DA-complexes of C<sub>60</sub>, as I have already mentioned above.

In other words, as the temperature drops, the solubility of hydrophilic polar HPh/C<sub>60</sub> DA-complexes in hydrophobic low-polarity OO decreases, causing the layering (separation) of chemical compounds available in C<sub>60</sub>/OO into two phases.

In general, on the basis of common examples of experiments held on “Large Rats” with C<sub>60</sub>/OO, we may assume that the more pronounced (definite) the layering effect is, the more that electron donor D-molecules (in our case – of HPh and water) contain the initial OO.

4. In view of the above mentioned information, we come to the most essential point, which is the explanation of the true cause of the positive effects of C<sub>60</sub> (*whether they are only for C60?*) revealed to date when applying C<sub>60</sub>/OO in “Small and Large Rats” (see the example here: [http://www.longecity.org/forum/topic/58783-poll-quantifying-c60oo-data/page\\_mode\\_show](http://www.longecity.org/forum/topic/58783-poll-quantifying-c60oo-data/page_mode_show)).

The main point is that the polar DA complexes, particularly HPh/C<sub>60</sub>, are stable in non-aqueous and rather hydrophobic media, such as vegetable oils. But as soon as such DA-complexes get into an aqueous medium, they start to break down there at some rate (whether this was high or low was not been studied in detail) under the influence of water molecules. In a scientific sense, this means that hydrolysis processes will take place due to the interaction of polar DA-complexes of C<sub>60</sub> with polar water molecules. This will eventually result in the decomposition of these DA-complexes into the their separate hydrated components. These components are denoted here as “HPh/H<sub>2</sub>O” and “C<sub>60</sub>/H<sub>2</sub>O”.

In general and in this particular case too, this will result in the formation of strong, highly hydrophilic hydrated  $C_{60}$  fullerenes ( $C_{60}HyFn = C_{60}@ \{H_2O\}_n$ , <http://www.longecity.org/forum/topic/57382-hydrated-fullerene-hyfn>), and, possibly, of various hydrated forms of nanoparticles/nanoaggregates of  $C_{60} = (C_{60})_m@(H_2O)_n$ . In these formulas, the symbol “@” shall mean that the m molecules of  $C_{60}$  are enclosed in a shell consisting of n molecules of  $H_2O$  (water).

5. Based on the results of research carried out by the Japanese scientists, we can assume that, regardless of the type of oil (Oil = OO, CO, FO etc.) used to prepare various samples of  $C_{60}$ /Oil and upon feeding them to rats, almost all the oil quantity is quickly absorbed in the gastrointestinal tract. As a result, all the black  $C_{60}$  non-absorbed (digested) residues on its (GIT) walls as some amorphous mass, while no (!) portion of the  $C_{60}$  from the amount introduced is absorbed by the “small rats”!

In other words, in actually appears that the major lipid and hydrophobic components of oils (triglycerides) are a very poor and ineffective means for transporting fullerene  $C_{60}$  through the walls of the GIT and delivering it to a living organism’s other organs and tissues.

However, upon feeding rats with  $C_{60}$ /OO for 7 days (daily dose of  $C_{60}$  equal to 4 mg/kg), the French researchers managed to discover fullerene  $C_{60}$  in the animals’ various organs (blood, liver, spleen, brain), although the doses were very low. These doses comprised 0.003% and 0.007% of the total accumulated dose (TAD) of  $C_{60}$  administered to to the “small rats” on the first and eighth day respectively. In conversion, the average dose corresponds to one a hundred-thousandth ( $1:100000$  or  $10^{-5}$ , or 10 ppm) dose of  $C_{60}$  TAD.

There is also an important fact proving that many samples of OO contain HPh in quantities up to 10 ppm (<http://www.oliveoilsource.com/page/chemical-characteristics>).

In other words, we can observe an interesting coincidence: compared to the TAD, the portion of  $C_{60}$  that was adopted by rats is the same as the concentration of HPh in OO!

This coincidence gives rise to a rather reasonable question: what was the vehicle for distributing  $C_{60}$  within the body if the lipid components of OO are poor candidates for such a role?

There is only one answer: it is the HPh of olive oil, which, as mentioned before, is able to form polar DA-complexes with  $C_{60}$  (HPh/ $C_{60}$ ).

However, when such HPh/ $C_{60}$  appears in the body and then quite certain biological effects appear, what was the real factor causing these effects?

This factor is simple, as you can see.

Regardless of where HPh/ $C_{60}$  happened to appear (whether they deposited on the surface of the GIT or entered its cells and intracellular space), all of them primarily interact with water, and there is always enough of it!

We shall also not forget that the rats, taking  $C_{60}$ /OO periodically, drank water regularly and that their GIT and any residues on its walls left upon after absorption of OO, were constantly wetted (hydrated) with water.

In general and as mentioned before, HPh/ $C_{60}$ , when in contact with water – the dominating formation of hydrated fullerenes ( $C_{60}HyFn$  or, generally,  $C_{60}/H_2O$ ) – is accompanied by displaying of a wide range of positive biological effects that have been revealed and confirmed in numerous tests of aqueous solutions of  $C_{60}HyFn$  ( $C_{60}FWS$ )

(see the examples provided at the following links:

<http://www.longecity.org/forum/topic/57382-hydrated-fullerene-hyfn/>

<http://www.longecity.org/forum/topic/59259-baati-rats-autopsied-no-cancer/>

<http://www.ipacom.com/index.php/en/publications-about-c60hyfn/70>

<http://www.ipacom.com/index.php/en/fullerenes-and-water-left/74>

<http://www.ipacom.com/index.php/en/production-left/68>

[http://www.ipacom.com/images/Articles/annotation\\_en.pdf](http://www.ipacom.com/images/Articles/annotation_en.pdf) ).

These links are not provided for advertising purposes and their  $C_{60}FWS$ . They are provided in order to enable users of this forum to see the amazing similarity of the positive biological effects that have been

scientifically determined in the case of C<sub>60</sub>HyFn and which, in the case of C<sub>60</sub>/OO, have been determined and summarized by enthusiastic volunteers, or “Large Rats” in the “C60health” forum (see, particularly: [http://www.longevity.org/forum/topic/58783-poll-quantifying-c60oo-data/page\\_mode\\_show](http://www.longevity.org/forum/topic/58783-poll-quantifying-c60oo-data/page_mode_show) and <http://c60antiaging.com/health-benefits-of-c60/buckyballs-the-secret-behind-centuries-old-health-spa/> (the Section “Health benefits of C60 in humans”))

Since, in this post, I have discussed the question about hydrated C<sub>60</sub> fullerene, it follows from the description presented on the IPAC LLC website, the physics-chemical and biological properties of C<sub>60</sub>HyFn, as well as a wide range of its positive biological activity, are determined not by the C<sub>60</sub> molecule itself, but relate to the unique properties of special extended water structures that C<sub>60</sub>HyFn creates around and supports for an indefinite period of time.

In other words, the C<sub>60</sub> molecule is only structure-organising principle (source). It is biologically inert and it does not get immediately involved in any biochemical reactions, including reactions with free radicals. This being said, however, C<sub>60</sub>HyFn exceeds any known antioxidants in terms of its antioxidant effect by hundreds or even thousands of times. In general, C<sub>60</sub>HyFn is a catalyst of the recombination (“self-neutralisation”) of free radicals in aqueous media. This is what differentiates it from the behaviour of the C<sub>60</sub> molecule in the medium of non-polar organic solvents, in which C60, as is supposed, operates as a kind of “sponge” for trapping free radicals. In the aqueous medium, it’s completely different!

See the following links to obtain information on the relevant mechanisms:

<http://dx.doi.org/10.1016/j.freeradbiomed.2009.06.016>

or

<http://api.ning.com/files/SX8ermG9424lhvFkeQcWoojpoYy-3icjwBcTJcYVN88FF4uhrWq7fO9GK7WHeymsW7tRjTfFmFwnbsPS9Xj5Ibp1v6K4sym/FRBMfulltext1.pdf>, as well as in the scientific publications and reports by IPAC LLC.

By the way, the above-mentioned article on the mechanisms of the antioxidant and radio-protective effect of C<sub>60</sub>HyFn, which is also cited in the Baati at al article, may explain the strange fact that the French and Japanese researchers were unable to detect any products of C<sub>60</sub>’s chemical interaction with free radicals, as is usually common for typical antioxidants. They also found no so-called C<sub>60</sub> metabolites with other biological molecules, which usually come into chemical interaction with allogenic (foreign) molecules in order to dispose (deallocate) of them.

In their earlier studies, F. Moussa et al. detected metabolites of C<sub>60</sub> with endogenous vitamin A (then, actually, they used micronised C<sub>60</sub> in an aqueous mixture of detergent and cellulose derivative – <http://dx.doi.org/10.1021/nl051866b>). However, no metabolites were found in their experiments with C<sub>60</sub>/OO, as are being discussed here. Why is this the case?

That is the reason that the properties of C<sub>60</sub>HyFn itself were seen as the cause of all the biological effects they detected here, but not the properties of the very C<sub>60</sub> molecule dissolved in OO!

First and foremost, this can be explained due to the numerous common physicochemical properties of C<sub>60</sub>HyFn (<http://www.ipacom.com/index.php/ru/published-works/71>), which prove the impossibility of the C<sub>60</sub> molecule, as part of C<sub>60</sub>HyFn, entering into chemical reactions with other molecules and free radicals under normal conditions. The reason for that is the strong hydration (water) shell of C<sub>60</sub>, which no molecules or free radicals are able to “break through” in order to form new chemical derivatives of C<sub>60</sub>.

The only conclusion that can be derived from the above information is that the causes of the positive biological effects, as revealed in the work by Baati at al and by our “Large Rats”, are determined (all of them) either due to the properties of C<sub>60</sub>HyFn or the processes of its formation in the body through the hydrolysis of HPh/C<sub>60</sub> complexes.

In such a case, we can assume that, upon the “Large and Small Rats” taking the C<sub>60</sub>/OO, the anticipated and detected biological effects, as well as their intensity, will depend significantly upon the content of HPh in OO (by the way, the more HPh there is, the thicker the green colour of the oil).

But then it is hard to escape from making a simple conclusion: in order to discuss and make some interim and objective conclusions as to the biological effect of  $C_{60}$  dissolved in some OO, it would be ideal if everyone used the same standardised sample (or grade) of OO (see the example on <http://olivecenter.ucdavis.edu/>, “Imported Extra Virgin olive oil often fails international and USDA standards” <http://olivecenter.ucdavis.edu/news-events/news/files/olive%20oil%20final%20071410%20.pdf>).

But that’s not the whole point since questions about the standardisation of processes for obtaining  $C_{60}$ /OO remain, and there are many of them.

To put it bluntly, problems exist now and they will undoubtedly emerge in the future as well!

To conclude this long monologue, let’s return to the question of extending life span.

In particular, the question is as follows: should we seek to extend the life span in any way (for example, to affect the telomeres or take heavy doses of certain antioxidants in attempts to saturate our mitochondria with them) and then, having extended it, turn into a “plant”? Or, if you seek to extend your life span, is it not correct to start it early in life, and to maintain and improve the quality of our everyday life?

Let’s hope that this fullerene  $C_{60}$  did not appear in our life accidentally and that, being a unique symbiosis of carbon and water,  $C_{60}$ HyFn can really help to improve our lives!

P.S.

1. By no means getting into scientific detail, let’s note that, in accordance with their chemical nature, the DA-complexes of  $C_{60}$  with polyphenols (compounds of “C-O” types) are less stable than the complexes of  $C_{60}$  with porphyrins (compounds of “C-N” types). Hence, the intensity of the biological effects of  $C_{60}$ /OO shall be determined according to the availability of porphyrin compounds in the oil.

2. Let’s indicate that porphyrin chlorophylls are compounds produced by plants but not by fish. Thus, as noted in the forum (<http://www.longecity.org/forum/topic/57619-c60-in-fish-oil/>, e.g. “zorba990” posted on August 01, 2012 about “C60 in Fish Oil”, <http://www.ncbi.nlm.nih.gov/pubmed/20621447>), the experiments involving mixtures of fish oil (FO) with  $C_{60}$  are unreasonable and cannot reveal any of fullerene  $C_{60}$ ’s additional positive effects upon the organism (!) when ingesting it as a mixture with various FO. Similar mixtures can be reasonably studied in terms of protecting the lipid components of fish oil against oxygenation and deterioration (rancidification) due to the antioxidant properties of  $C_{60}$  (it serves a kind of “sponge” for free radicals, but not in non-aqueous media)).

3. Upon analysing the data received in the process of working with Baati et al. and considering the invaluable experience being reported with respect to the “Large Rats” in the [LONGECITY](#) →.... [C60health](#) forum, I can note that, in order to achieve positive biological effects that are similar in their nature and intensity (including that pertaining to antioxidants), as revealed in the application of  $C_{60}$ HyFn (as  $C_{60}$ FWS, see the example at: [http://www.ipacom.com/images/Articles/annotation\\_en.pdf](http://www.ipacom.com/images/Articles/annotation_en.pdf)), it is necessary to apply doses of  $C_{60}$  (in form of  $C_{60}$ /OO) that are approximately one million ( $10^6$ ) times higher than the doses of  $C_{60}$ HyFn!

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11/17/2012

(starting from the date that it is commercially available of “ $C_{60}$ Water of Life<sup>®</sup>” (Water with Hydrated  $C_{60}$  Fullerene).

## PART 2

**TO THE QUESTION ON THE FORMATION POSSIBILITY OF SOME “ADDUCTS” OF C<sub>60</sub>  
WITH FATTY ACIDS DURING C<sub>60</sub> DISSOLUTION IN OLIVE OILS.**

September 27, 2012 DeadMeat make post #68 on [http://www.longecity.org/forum/topic/57849-equipment-mixing-centrifuging-and-filtering/page\\_view\\_findpost\\_p\\_537336](http://www.longecity.org/forum/topic/57849-equipment-mixing-centrifuging-and-filtering/page_view_findpost_p_537336), in which he cited the work of Franco **Cataldo**. Solubility of Fullerenes in Fatty Acids Esters: A New Way to Deliver In Vivo Fullerenes. Theoretical Calculations and Experimental Results. Chapter 13 in "Medicinal Chemistry and Pharmacological Potential of Fullerenes and Carbon Nanotubes Carbon Materials: Chemistry and Physics", 1, **2008**, 317-335. [http://dx.doi.org/10.1007/978-1-4020-6845-4\\_13](http://dx.doi.org/10.1007/978-1-4020-6845-4_13).

The full text of this article could have been found also some time ago on: <http://www.owndoc.com/pdf/solubility-of-fullerenes-in-oil.pdf> (from the beginning 2013 Ukrainian internet-servers have ceased to see the site of Vaughter Wellness. It is interesting, why?)

In this article, on page 331-332, the spectra of C<sub>60</sub> solutions in oils are shown and, particularly, it is stated that:

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 "...The new absorption band at 435 nm in the C<sub>60</sub> spectrum has been attributed to the 1,2 addition to the fullerene cage to the fatty acid chains either across to the double bonds by a Diels-Alder addition or, more simply, by radical addition (Cataldo and Braun, 2007). Thus, fatty acid esters are able to not only dissolve C<sub>60</sub>, but also react with this molecule causing the addition of the fatty chain to the fullerene cage. In fact, the bands at 435 nm shown in Fig. 13.3 appear only when C<sub>60</sub> is stirred at 75°C for a couple of hours in the esters of fatty acids. Only for olive oil the new band appears much weaker than in the other cases and displaced at 450 nm (Fig. 13.3B). Since this oil contains chlorophyll, the displacement may be probably due also to a charge–transfer interaction between C<sub>60</sub> and chlorophyll or with other impurities. On standing in air, at room temperature the C<sub>60</sub> fullerene solutions in vegetable oils are not stable, but change their colour from violet to reddish. The electronic absorption spectra show a gradual increase in the absorption band in the visible initially in the range between 450 and 550 nm. Similar results are obtained both by heating the solutions in air or under nitrogen. In the latter case prolonged heating is needed to achieve the same results. Heating C<sub>60</sub> solutions in linseed or other oils for 15 minutes at 150°C (in air) causes the entire spectrum of C<sub>60</sub> in the visible to disappear completely as shown in Fig. 13.3F..."

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 The same words and spectra (see **Fig. A** below) have been given in his earlier work (e.g. Fig. 13.3F = Figure 1F in **F. Cataldo and T. Braun (2007)**, 'The Solubility of C<sub>60</sub> Fullerene in Long Chain Fatty Acids Esters', Fullerenes, Nanotubes and Carbon Nanostructures, 15:5 331-339, <http://dx.doi.org/10.1080/15363830701512450>).

For comparison, I give below the C<sub>60</sub> spectra (**Fig B**, from the article of Nobel Prize winner H. Kroto, who discovered fullerenes), showing that in the range between 450 and 550 nm the characteristics of C<sub>60</sub> spectra in hexane are similar to the spectra indicated by F. Cataldo.

Fig. A

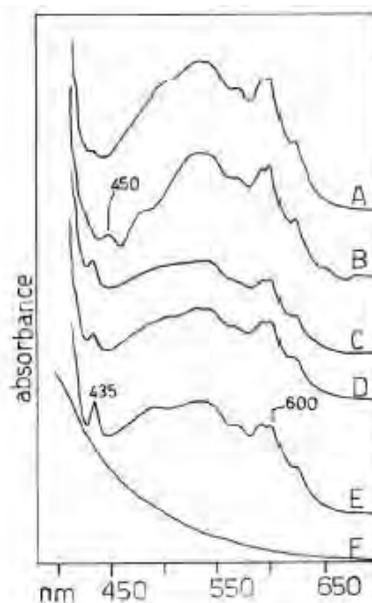


Figure 1. Electronic absorption spectra of  $C_{60}$  fullerene dissolved in: (A) Brassica oilseeds methyl ester (Biodiesel); (B) Olive oil; (C) Sunflower oil; (D) Soybean oil; (E) Linseed oil; (F) Linseed oil and  $C_{60}$  fullerene after heating at  $150^{\circ}\text{C}$  for 15 minutes.

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Fig. B

### Preparation and UV/visible spectra of fullerenes $C_{60}$ and $C_{70}$

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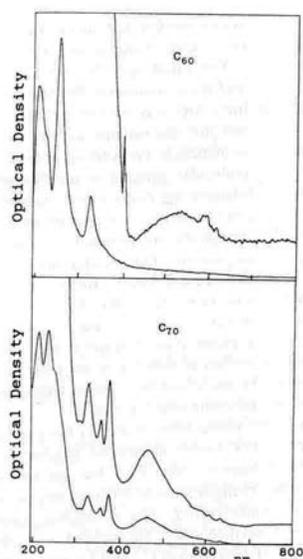


Fig. 4. UV/visible electronic spectra between 200 and 800 nm in spectroscopic hexane solution of (above)  $C_{60}$  and (below)  $C_{70}$ .

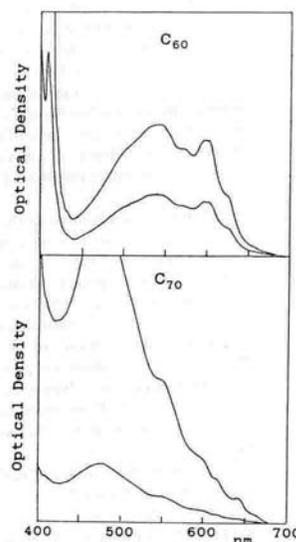
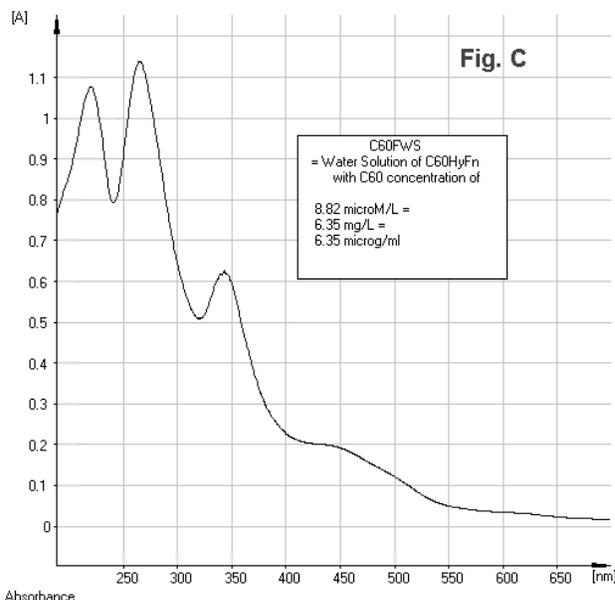


Fig. 5. UV/visible electronic spectra of the very weak features between 400 and 700 nm in benzene solution of (above)  $C_{60}$  and (below)  $C_{70}$ .

Such spectra characteristics are related to the low-intensity absorption bands so called forbidden electron transitions in the symmetric molecule  $C_{60}$ . As soon as  $C_{60}$  molecule forms either donor-acceptor complexes (e.g., see below spectrum of  $C_{60}HyFn$ , **Fig. C**), or forms mono-, bi-, tris-, etc. adducts with other molecules, these peculiarities immediately disappear in the absorption bands as a result of the symmetry breaking of electronic oscillations in pristine  $C_{60}$  molecule.



Note that known to me  $C_{60}$  solutions in OO, that were prepared within some weeks, have peculiarities of the  $C_{60}$  electronic spectrum (in the range of 420 and 650 nm) are completely similar to the spectrum of  $C_{60}$  solutions in ‘lipid-like’ hexane (like in Kroto’s work, see Fig. B).

And what is very important is that the growth of the intensity of these absorption bands was directly proportional to the portion of dissolved  $C_{60}$ !

From all above mentioned information, the conclusion is that the solubility of  $C_{60}$  in OO is not a result of formation of some  $C_{60}$  “adducts” with unsaturated fatty acids of triglycerides of OO.

However, we shall return to the article of Cataldo et al (2008), where, for some obscure reason, he decided not to mention interesting facts about date of FT-I(nfra)-R(ed) spectroscopy of solutions of  $C_{60}$  in oils and of which he informed in his article for 2007. There it has been told:

“...We have run another experiment under more drastic conditions: heating linseed or other oils for 15 minutes at 150° C (in air). Under these circumstances, the entire spectrum of  $C_{60}$  in the visible disappears completely as shown in Figure 1F, suggesting a more complex reaction between  $C_{60}$  and fatty acids. Unfortunately, the FT-IR spectroscopy made on these samples was not sensitive enough to give us any further indications about the reaction of  $C_{60}$  with the solvent medium” ...

What could that mean?

Trying to understand the causes of dissolution of  $C_{60}$  in OO, Cataldo et al (2007) were surprised by negative results of FT-IR analysis (besides, it is a very sensitive analytical method), when they could not find any products of chemical interaction of  $C_{60}$ . Nevertheless, they resolved to assume that one of the causes of dissolution is Diels–Alder reaction  $C_{60}$  with unsaturated fatty acids.

=====  
OK! Lets see on Wikipedia:

"The Diels–Alder reaction is an organic chemical reaction (specifically, a cycloaddition) between a conjugated (1,3-)diene and a substituted alkene, commonly termed the dienophile, to form a substituted cyclohexene system".

Conjugated 1,3-dienes has common formula  $R_1-CH=CH-CH=CH-R_2$ .

It is important that in many known Diels–Alder reactions  $C_{60}$  acts as dienophile and does not exhibit characteristics of conjugated 1,3-diene.

In our case and according to the mechanism of Diels–Alder reaction, in order that adducts of  $C_{60}$  with unsaturated fatty acids of olive oil could be produced, these fatty acids must have  $-CH=CH-CH=CH-$  fragments in their chemical structure.

Polyunsaturated fatty acids with such structures are not found in the olive oil and even if available in it than they are in negligibly small quantity.

On the other hand, the work of Cataldo states that polyunsaturated fatty acids with such fragments can be produced under the influence of thermal oxidation and oxidative (radical) polymerization, as it was found with linolenic and linoleic acids. Such processes require quite a significant heating (e.g. much more than  $75^\circ C$ ) of fatty acids at presence of atmospheric oxygen (for comparison, see, e.g. <http://dx.doi.org/10.1016/j.cplett.2013.02.035> !!!).

Similar heat treatment, as we know and understand, shall not be applied when preparing  $C_{60}$ \_EVOO!

Taking into account all the above mentioned we can draw conclusion that there are no strong scientific evidences allowing to state that, when preparing  $C_{60}$ \_OO, some covalent adducts of  $C_{60}$  with natural fatty acids are produced in it. Moreover, there are no reasons to claim that in  $C_{60}$ \_OO the whole  $C_{60}$  is available in the form of similar adducts.

That is why the statement that bioactivity of  $C_{60}$ \_OO is stipulated by adducts of  $C_{60}$  with natural (unoxidized) unsaturated fatty acids is incorrect and hasty!

In such case, what is an alternative for  $C_{60}$  “adducts” to explain bioactivity of  $C_{60}$ \_EVOO?

For that purpose we shall consider the problem of solubilization of  $C_{60}$  in water through ionic and nonionic detergents (SDS, CTA, Tween-s, Triton-s, PVP, etc). There are enough facts for discussing of such problem in the scientific literature. In this case, to please for seeming and “standard” highly hydrophobic properties of  $C_{60}$ , it is considered that the solubilization of  $C_{60}$  itself takes place due to hydrophobic interactions of  $C_{60}$  with hydrophobic “tails” of such detergents.

But what is actually observed in such cases?

At the first stage of solubilization, and due to hydrophobic interactions with lipid-like chains of oils, really the systems get magenta shades (typical color for solutions of  $C_{60}$  in hydrophobic solvents such as hexane, toluene and similar ones).

However, later the color of such systems (solutions) changes to reddish-brown and their absorption spectra become quite like spectra of  $C_{60}$ HyFn solutions. Why? And here the issue is not about the oxidation processes or detergents (their lipidic components), or  $C_{60}$  itself.

The cause of color change is in the solution structure transformation so that it becomes more advantageous for  $C_{60}$  molecules to “adapt” in the solution and to create a stable system not due to their interaction with hydrophobic lipid-like chains, but due to donor-acceptor (charge transfer) interactions with polar groups of detergents.

In case of OO, such donor-acceptor interactions establish between  $C_{60}$  and carboxyl  $[Ri-C(=O)O-Rj]$  groups of triglycerides of fatty acids with creation of weak donor-acceptor complexes  $C_{60}$  with their polar  $-C(=O)O-$  fragments.

Such transformations cause appearance and increase in reddish-brown color during  $C_{60}$  dissolution in OO.

In other words, upon dissolving C<sub>60</sub> in OO, in oily solution we have a great number of polarized donor-acceptor complexes with chlorophylls, and with polyphenols, and with triglycerides, and with other molecules which can contain in various sorts of OO.

Such donor-acceptor complexes can interact with water, hydrolyze and, later, facilitate of Hydrated Fullerenes formation (<http://www.longecity.org/forum/topic/60736-c60oo-positive-bioactivity-relates-to-hydrated-fullerene-hyfn-formation/>)!

And as we know, it is enough to have very small (“homeopathic”) doses and concentrations of Hydrated Fullerenes in order to the biological effects, much like those that were already found by Big Rats in their experiments with C60\_EVOO, become apparent (were visualised).

### **Conclusion:**

Till now there are no strict scientific proofs, what is actually the active principle in C<sub>60</sub>\_OO which causes some positive biological effects of C<sub>60</sub>\_OO which, however, in many respects coincide with that can do C<sub>60</sub>HyFn and its water solutions.

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