

Can [60]fullerene maintain good health and prolong lifespan?

Fatalists aside, who doesn't want to live longer and in good health? But, obviously, to live longer it would be nonsense to put our health at risk. Yet, since we published a paper in 2012 on prolonging the lifespan of rats by repeated administration of [60] fullerene (C_{60}), myriad websites have started selling this product online as a dietary supplement without any certified toxicity test!

Safety precautions

Since the early nineties countless publications have reported promising medicinal applications for C_{60} mostly related to its unparalleled affinity towards free radicals. However, until now no officially approved C_{60} -based drug has reached the market, notably because of the alleged dangers of C_{60} nanoparticles.

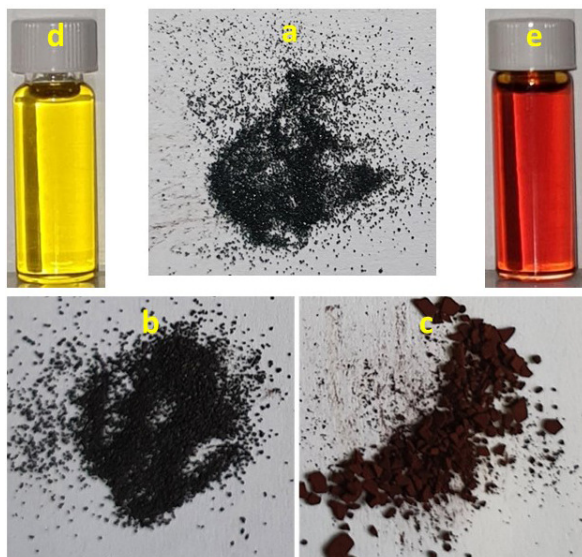


Fig. 1. [60]Fullerene (C_{60}), powders and oily solutions. (a) 99.99 % purity; (b) 99.95 % purity; (c) C_{60} aggregates obtained by cosolvent precipitation; (d) virgin olive oil, used as solvent; (e) C_{60} -olive oil.

From our experience in the field of biomedical applications of fullerenes, we know that pure C_{60} has neither acute nor chronic toxicity. Nevertheless, we also know that under certain conditions, linked to the presence of impurities into C_{60} aggregates or to defective adjuvants or to light exposure, certain preparations based on this product, can be highly toxic. Hence, it is important above all to avoid using C_{60} in solid form, i.e. in the form of aggregates or nanoparticles. Especially since, we should remember, C_{60} is active only in soluble form. Overall, it is mandatory to verify the innocuousness of any C_{60} -containing preparation proposed for human consumption.

Is C_{60} active in all species regardless of age?

Recently, two studies found no beneficial effect of C_{60} administration on aging in mice. The authors therefore questioned the generalizability of the efficacy data across different species and age ranges. Meanwhile, many

consumers testify online about the benefits of C₆₀ on their health. But, of course, these testimonies, whether solicited or not by the sellers, cannot be accepted only for the omission of the placebo effect.

While pharmacokinetics data are missing in both studies in mice – *i.e.* we do not know if the administered ingredient is well absorbed and if so to what extent? -, their results clearly remind us, if needed, that clinical trials are unavoidable before proposing any C₆₀ preparation for human consumption.

Towards Regulatory Considerations

In order to perform successful clinical trials, the purity of an active pharmaceutical ingredient is a crucial prerequisite. This should also apply to C₆₀, even though it is only sold as a dietary supplement.

In order to build a quality-testing strategy for regulatory considerations, we have recently evaluated several analytical tools to verify the purity of commercially available C₆₀ samples. Our data clearly show that differential scanning calorimetry is the best choice to establish a purity criterion based on the sc-fcc transition of a C₆₀ sample ($T_{\text{onset}} \geq 258 \text{ K}$, $D_{\text{sc-fcc}}H \geq 8 \text{ J/g}$). Nevertheless, even the visual aspect of a C₆₀ sample can already provide clues as to its quality.

Highly pure C₆₀ samples are crystalline and exhibit a black metallic appearance (Fig. 1a), whilst less pure C₆₀ samples are less crystalline, and possess a brownish color (Fig. 1b, and c). Furthermore, oily solutions of C₆₀ are clear and have a purplish orange rose color, the intensity of which depends on the concentration (Fig. 1). This color results from mixing the yellow color of the oil and the violet color of C₆₀ in solution. Any cloudy or differently colored solution should be discarded.

As there are neither regulatory recommendations on this subject nor a purity criterion for C₆₀ samples until now, C₆₀ consumption could cause a public health issue. This would be doubly damaging. First of all, for consumers' health of course, but also this could permanently compromise a product which is so promising for human health.

Fathi Moussa

Institut de Chimie Physique, CNRS – UMR 8000, Université Paris – Saclay, France

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