C0r0n@ 2 Inspect

Review and analysis of scientific articles related to experimental techniques and methods used in vaccines against c0r0n@v|rus, evidence, damage, hypotheses, opinions and challenges.

Monday, August 16, 2021

Lactic acid bacteria could protect against graphene oxide toxicity in the gut

Reference

Zhao, Y .; Yu, X .; Jia, R .; Yang, R .; Rui, Q .; Wang, D. (2015). Lactic acid bacteria protects Caenorhabditis elegans from toxicity of graphene oxide by maintaining normal intestinal permeability under different genetic backgrounds. Scientific reports, 5 (1), pp. 1-13. https://doi.org/10.1038/srep17233

Facts

1. Lactic acid bacteria, also known as BAL or LAB are a heterogeneous group of microorganisms that are characterized by producing lactic acid, fermenting carbohydrates. According to (Requena, T. 2018) the genera that are usually found in these groups are Lactococcus, Lactobacillus, Leuconostoc, Pediococcus, Streptococcus, Aerococcus, Oenococcus, Carnobacterium, Enterococcus and Weissella among others. LABs are used in the fermentation of foods, so their role is fundamental in human health. Taking this into account, the researchers (Zhao, Y.; Yu, X.; Jia, R.; Yang, R.; Rui, Q.; Wang, D. 2015) use the "*Caenorhabditis elegans (nematode) to investigate the possible beneficial effect of pretreatment with LAB (Lactobacillus bulgaricus) against the toxicity of graphene oxide (GO) and the underlying mechanisms* . "Initial results confirmed the hypothesis that" *LAB prevented the toxicity of the Graphene oxide GO in the functions of primary and secondary target organs in nematodes. LAB blocked GO translocation in secondary target organs through the intestinal barrier, maintaining normal intestinal permeability* . "This information could be very important to help mitigate or counteract the effects of graphene oxide, as can be deduced from the claims made by scientists.
2. It is worth noting the important mention of the authors to the toxicity of graphene oxide GO, which causes cytotoxicity, in-vivo and in-vitro adverse effects, pulmonary toxicity, reproductive toxicity in mammals, genotoxicity, intestinal dysfunctions and cellular damage, being referred to and described in the scientific literature, see (Akhavan, O.; Ghaderi, E.; Rahimi, K. 2012 | Yang, K.; Li, Y.; Tan, X.; Peng, R.; Liu, Z. 2013 | Zhao, Y.; Wu, Q.; Li, Y.; Wang, D. 2013 | Yuan, J.; Gao, H.; Sui, J.; Duan, H.; Chen, WN; Ching, CB 2012 | Qu, G.; Liu, S.; Zhang, S.; Wang, L.; Wang, X.; Sun, B.; Jiang, GB 2013 | Li, Y.; Wu, Q.; Zhao, Y .; Bai, Y.; Chen, P.; Xia, T.; Wang, D. 2014 | Li, B.; Yang, J.; Huang, Q.; Zhang, Y.; Peng, C.; Zhang, Y.; Fan, C. 2013 | Akhavan, O.; Ghaderi, E.; Hashemi, E.; Akbari, E. 2015 | Fu, C.; Liu, T .; Li, L .; Liu, H .; Liang, Q .; Meng, X. 2015) and bibliographic page of damages and toxicity of this blog .

3. On the other hand, the researchers describe " *several cellular mechanisms to explain the toxicity of GO: 1) direct contact interaction of the ultra-sharp edges of GO with the cell membrane, 2) induction of the production of reactive oxygen species (ROS) . and 3) wrapping cells or microorganisms and aggregation in the culture medium* "(Akhavan, O.; Ghaderi, E. 2010 | Hu, W.; Peng, C.; Lv, M.; Li, X.; Zhang, Y .; Chen, N.; Huang, Q. 2011 | Chang, Y.; Yang, ST; Liu, JH; Dong, E.; Wang, Y.; Cao, A.; Wang, H. 2011 | Akhavan, O .; Ghaderi, E.; Akhavan, A. 2012 | Akhavan, O.; Ghaderi, E.; Esfandiar, A. 2011 | Akhavan, O.; Ghaderi, E.; Esfandiar, A. 2011 | Hashemi, E.; Akhavan, O.; Shamsara, M.; Rahighi, R.; Esfandiar, A.; Tayefeh, AR 2014)

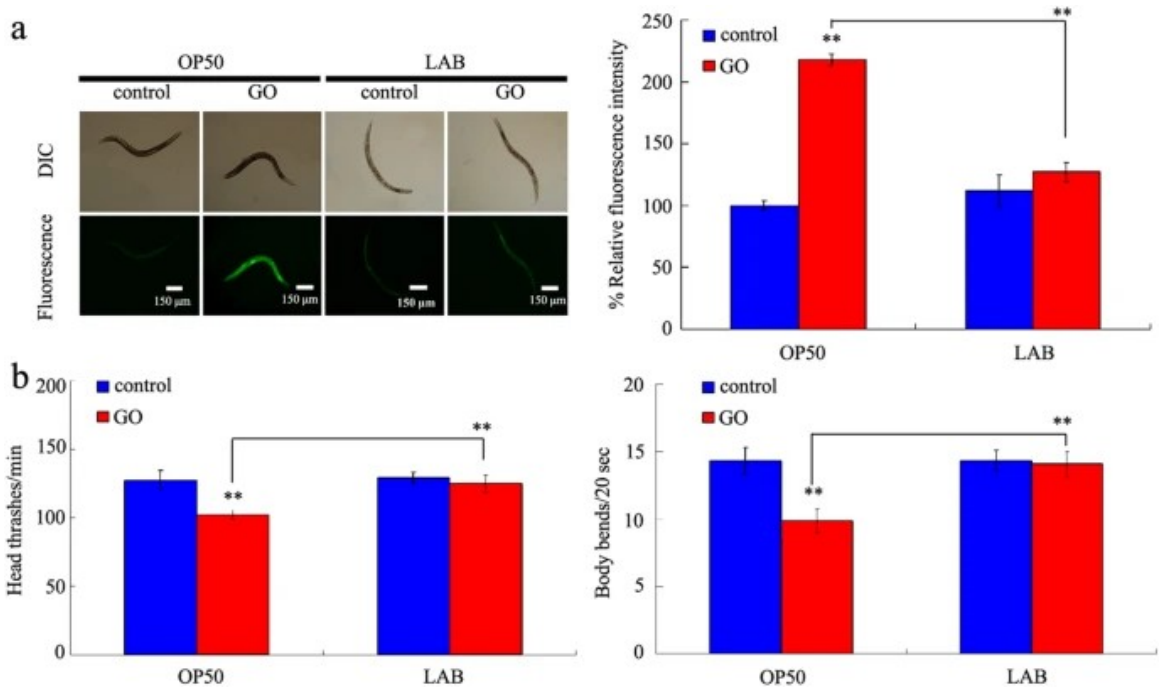

Fig. 1. Administration of LAB (Lactic Acid Bacteria) reduced toxicity to levels similar to control nematodes. (Zhao, Y.; Yu, X.; Jia, R.; Yang, R.; Rui, Q.; Wang, D. 2015)

4. The research describes the experimental procedure / methodology in an in-vivo nematode (Caenorhabditis elega), in order to experience the toxicity of (ENM) or engineering nanomaterials developed with GO graphene oxide, and to know the consequences that they would entail in mammalian or human " *engineered nanomaterials (ENM) can be translocated to primary target organs (like the intestine) and / or secondary target organs (like neurons and reproductive organs* "
5. The intestine plays a crucial role as a " *biological barrier against the possible toxicity of NMDs in nematodes* ". If this has been verified in nematodes, it would also be extrapolated to mammals and humans.
6. The researchers provide very relevant information in the following statement " *The functioning of the intestine participates in the control of the defecation behavior of C. elegans and can be used successfully for the evaluation of toxicity and the toxicological study of carbon-based ENMs. Such as graphite, multi-walled carbon nanotubes (MWCNT) and fullerenol* . "Until now, graphene oxide was known in 2D form (1 atom thick nano-sheets), in 3D form (several layers stacked on top of each other), in the form of nanotubes (graphene oxide cylinders, also known as carbon nanotubes), in the form of multi-walled nanotubes (referred to as MWCNT, which are graphene oxide cylinders organized within each other) and a new, unknown shape, the " *fullerenol* ", also known as "*fullerene* "which

is a 3D geometric molecule of carbon with ellipsoid / spherical shape, see figure 2. This component is very relevant for the investigation of the toxic effects of graphene oxide in the human body, the detection of new vectors of pollution, so it will be discussed in detail in future posts.

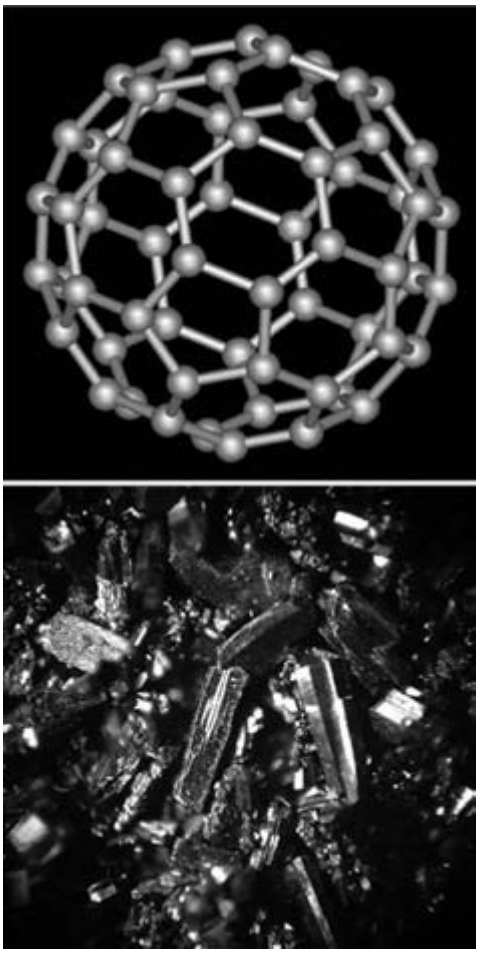

Fig. 2. C60 fullerene molecule and fullerene crystals. Illustration obtained from Wikipedia (https://en.wikipedia.org/wiki/Fullerene)

4. To conduct the experiment, the researchers " *selected the endpoint of intestinal reactive oxygen species (ROS) production* ." This is the observation of the toxicity of graphene oxide in nematodes when administering LAB (Lactic acid bacteria) and their intestinal reaction in the generation of free radicals (ROS). According to this method, it was observed that " *administration with LAB altered the translocation pattern of GO in nematodes ... After pretreatment with LAB, graphene oxide GO was mainly distributed in the pharynx and intestine and no signals were detected in secondary target organs of nematodes* ". This allows us to affirm that "*Administration with LAB was useful to maintain the normal state of intestinal permeability in nematodes exposed to GO* . "This could be ascertained thanks to the use of fluorescent dye" Nile red ". Other evidence of the effects of LAB on graphene oxide is defecation behavior " *Administration with LAB maintained normal defecation behavior in nematodes exposed to GO ... pretreatment with LAB notably recovered the toxic effect of GO, recovering the normal defecation cycle* ." This could be verified with the test of fluorescence that was significantly reduced compared to untreated nematodes. Other important evidence has to do with the reduction of the toxicity of graphene oxide "*Administration with LAB prevented GO toxicity in nematodes with susceptible gene mutations* . "The researchers found that oxidative stress generated by the sod-2, sod-3, gas-1 or aak-2 genes caused toxic reactions when interacting

with graphene oxide GO. This is because " *the sod-2 and sod-3 genes encode mitochondrial manganese superoxide dismutases, the gas-1 gene encodes a subunit of the mitochondrial complex I, and the aak-2 gene encodes a catalytic alpha subunit of protein kinase* . "Graphene oxide induced the mutation of the sod-2, sod-3, gas-1 or aak-2 genes, which caused severe production of ROS or free radicals, responsible of cell death. However "*We discovered that pretreatment with LAB could still effectively suppress the induction of intestinal ROS production and the decrease in locomotion behavior in the GO-exposed sod-2, sod-3, gas-1 or aak-2 mutants, leading to conclusion that pretreatment with LAB may have the beneficial effect of being against GO toxicity in nematodes* ".

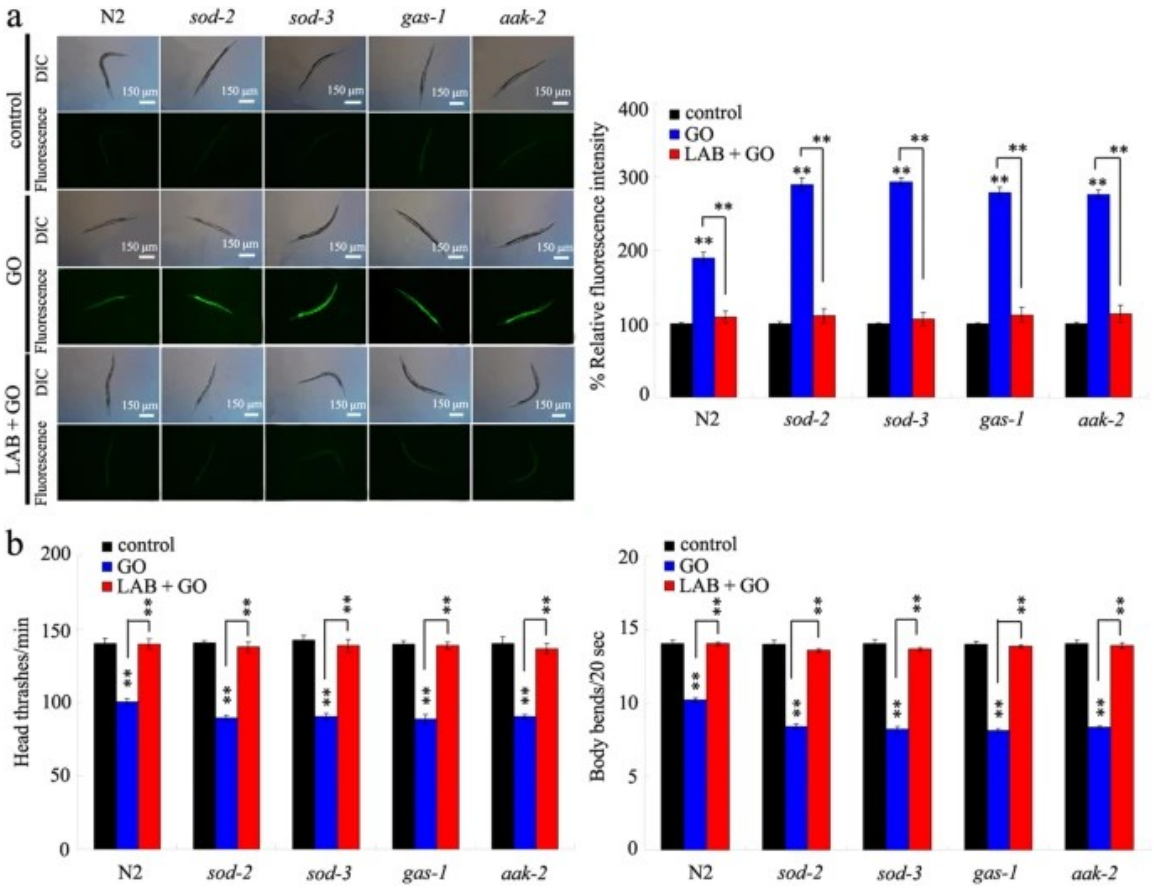

Fig. 3. Note that the control and LAB treatment values are on par. This means that lactic acid bacteria can neutralize the effects of graphene oxide, at least in the gut. (Zhao, Y .; Yu, X .; Jia, R .; Yang, R .; Rui, Q .; Wang, D. 2015)

8. As a final conclusion, the researchers state that "*LAB pretreatment could effectively suppress the toxicity of GO exposure on primary and secondary target organ function in nematodes. One of the main cellular mechanisms for the beneficial effects of LAB pretreatment is the maintenance of normal intestinal permeability in GO-exposed nematodes. Another cellular mechanism for the beneficial effects of LAB pretreatment is the maintenance of normal defecation behavior in GO-exposed nematodes. The combined effects on intestinal permeability and defecation behavior by LAB pretreatment prevented translocation of GO to secondary target organs or bioavailability of GO to body cells across the intestinal barrier in nematodes. One of the important molecular mechanisms for the beneficial effects of LAB pretreatment is that LAB can exert its beneficial effects against GO toxicity."Including, LAB treatment would have" beneficial effects against GO toxicity even in nematodes with gene mutations capable of generating toxic reactions to graphene oxide exposure* . "

Graphene oxide mitigation by protein saturation

1. According to the researchers (Hu, W.; Peng, C.; Lv, M.; Li, X.; Zhang, Y.; Chen, N.; Huang, Q. 2011) another way to reduce the cytotoxicity of graphene oxide is to saturate it with proteins, forming what is known as a " *protein crown* ". They state that " *the cytotoxicity of GO nanosheets arises from direct interactions between the cell membrane and GO nanosheets that cause physical damage to the cell membrane. This effect is greatly attenuated when GO is incubated with FBS due to the adsorption capacity of extremely high protein from GO* ". FBS, also known as fetal bovine serum, is a supplement that promotes the growth and adhesion of cell cultures in laboratories.
2. Observations revealed that " *a large amount of proteins had coated the surfaces of the GO nanosheets (designated as GO coated with FBS). Furthermore, binding to the GO-FBS protein reached equilibrium within 30 min* ." Knowing the enzymatic adsorption capacity of graphene oxide, demonstrated in the filters for the separation of lactose , it is not surprising that it is also capable of protein adsorption, which is why this saturation tactic is ingenious. This was reflected in later tests in which the "*GO graphene oxide nanofolds were able to adsorb approximately 1.6 mg of BSA (bovine serum albumin). This loading capacity was respectively ~9 times and ~1.8 times greater than that of BSA for two well-known nanomaterials with high protein adsorption capacity, namely, multi-walled carbon nanotubes (MWNT) and carbon nanotubes of single wall (SWNT). These data suggested that the GO nanosheets possessed exceptionally high adsorption capacity for proteins abundant in the FBS medium* . "Since the GO nanosheets were coated with proteins, it could not cut or damage cell membranes, thus reducing cell membranes. Direct interactions with cells, thereby avoiding oxidative stress, metal toxicity, and cell physical perforation.

Removal of graphene oxide by UV treatment of food

1. Another way to combat graphene oxide could be the UV treatment of food. According to (Wu, Q .; Zhao, Y .; Fang, J .; Wang, D. 2014) "*The rise of GO graphene oxide around the world makes it likely that it poses a significant environmental and health risk. In-vitro exposure to GO causes a decrease in cell viability and adhesion, induction of cell apoptosis, alteration of lactate dehydrogenase release, and oxidative stress. In vivo studies have shown the biodistribution and biopersistence of GO after exposure. In-vivo exposure to GO produces inflammatory cell infiltration, pulmonary edema and granuloma formation, increased mitochondrial respiration rate, generation of reactive oxygen species (ROS), and activated inflammatory pathways and apoptosis. Furthermore, there is evidence that the long-term adverse health effects of GO graphene oxide should be carefully considered in future applications*."According to the scientific literature that was consulted, see (Wang, K.; Ruan, J.; Song, H.; Zhang, J.; Wo, Y.; Guo, S.; Cui, D. 2011 | Liao, KH; Lin, YS; Macosko, CW; Haynes, CL 2011 | Lv, M.; Zhang, Y.; Liang, L.; Wei, M.; Hu, W.; Li, X.; Huang, Q. 2012 | Duch, MC; Budinger, GS; Liang, YT; Soberanes, S.; Urich, D.; Chiarella, SE; Mutlu, GM 2011 | Zhang, X.; Yin, J.; Peng, C.; Hu, W .; Zhu, Z.; Li, W.; Huang, Q. 2011 | Zhang, X.; Yin, J.; Peng, C.; Hu, W.; Zhu, Z.; Li, W.; Huang, Q. 2011 | Yang, K.; Gong, H.; Shi, X.; Wan, J.; Zhang, Y.; Liu, Z. 2013 | Sanchez, VC; Jachak, A.; Hurt, RH; Kane, AB 2012). This problem led the authors to study methods to combat or eliminate graphene oxide or its toxicity. In fact, they testify that "*in mice, GO could accumulate in the lung, liver, spleen and kidney target organs. Studies of GO toxicities both in-vitro and in-vivo have suggested that ROS production in target cells is a potential mechanism. However, the toxicology and behavior of*

GO in biological systems after prolonged exposure is still unclear. " With this statement, the researchers are aware of the cellular damage caused by graphene oxide in the form of ROS (reactive oxygen species) that cause free radicals and apoptosis.

8. In the experiment they carry out (Wu, Q .; Zhao, Y .; Fang, J .; Wang, D. 2014) C. elegans (nematode) were fed " *Escherichia coli OP50* ", which is a bacterium modified to serve as food under laboratory conditions. The " *Escherichia coli* " has the peculiarity that it is also found in the gastrointestinal tract of the human being, which allows inferring the laboratory results of a nematode, as a simulation of what would happen to people. The authors state that "*The OP50 feed that was UV treated suppressed the toxicity of chronic GO exposure. To further determine the possible role of severe OP50 accumulation in mediating GO toxicity, we used UV-treated OP50 to feed GO-exposed nematodes. The feeding with OP50 treated with UV was carried out from day 1 of the adult. In growth plates spread with UV-treated OP50, nematodes exposed to GO at the examined concentration (1mg / L-1) exhibited locomotion behaviors similar to those of control nematodes. Furthermore, nematodes exposed to GO at the concentration examined (1mg / L-1) did not show a significant induction of intestinal auto-fluorescence or intestinal ROS production*."This means that food treated with ultraviolet UV light, would prevent the cytotoxic effects of graphene oxide in the body of nematodes and in theory, therefore in that of people. In fact, it refers to" *Modifying the PEG surface suppressed both GO deposition and OP50 accumulation in the gut of nematodes*, "this is the removal of graphene oxide from the digestive system, as well as the bacterium" *Escherichia coli* "partially.

Reviews

1. It seems to be demonstrated that lactic acid bacteria could eliminate GO graphene oxide in the intestine and prevent its deposition, returning the treated animal to normal, control levels. The relationship between lactose-free products and lactose intolerance problems is very curious, as is the article analyzed (Zhao, Y.; Yu, X.; Jia, R.; Yang, R.; Rui, Q.; Wang, D. 2015) on the beneficial effects of BAL / LAB (lactic acid bacteria). If a person has a low BAL / LAB level, they are likely to be lactose intolerant and thus more likely to suffer from the toxic effects of graphene oxide. If, on the contrary, your digestive system has adequate and properly enhanced bacterial flora, toxicity can be reduced or even partially eliminated.previous post on graphene oxide and lactose intolerance , GO graphene oxide has the ability to inhibit enzymes like lactase and filter lactose. If people neglect lactose products, they do not promote the growth of lactic acid bacteria and thus partial, natural immunity to graphene oxide. Consequently, it seems important to analyze these factors in affected people, in order to reliably ensure a BAL / LAB deficit and thereby verify a new treatment against graphene oxide. Taking into account all the evidence, it seems that a healthy practice could be the intake of natural yogurts, avoiding those of the highly industrialized, processed type.
2. Given the capacity of graphene oxide for the adsorption of enzymes and proteins, a strategy to inhibit its capacities is through protein saturation, according to (Hu, W.; Peng, C.; Lv, M.; Li, X.; Zhang, Y.; Chen, N.; Huang, Q. 2011). However, in the literature consulted, there is no evidence of its performance outside the laboratory in-vivo in the cases of people poisoned with graphene oxide. Perhaps, it would be a good strategy to research effective and cheap solutions to deal with the problem until the human body is able to remove most of the toxic graphene.

3. Treating food with UV ultraviolet light could significantly reduce the amount of GO graphene oxide that is ingested or its consequences, preventing it from being deposited in the digestive system, in addition to reducing its incidence in the rest of the body. While this may seem strange, it is not, since according to (Spilarewicz-Stanek, K.; Jakimińska, A.; Kisielewska, A.; Dudek, M.; Piwoński, I. 2021), ultraviolet light initiates a procedure called oxidation photodegradation in graphene oxide, which depends on the intensity, the type of irradiation and the time applied. It is for this reason that clothing made with graphene oxide is designed to resist visible light and ultraviolet light., in order to avoid damage to the graphene structures. It is also possible to carry out experimentation and laboratory tests for the decontamination of food using UV light, in order to ensure the elimination of graphene oxide and ensure that the food can be prepared and consumed later.

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