WHITEPAPER 2025

THE SCIENCE BEHIND LiFT®

4GOLD

ABSTRACT

LiFT® stands for Lipid Fuel Technology, and is a supplement that has the power and potential to redefine the current old school approach of fueling exercise with solely carbohydrates. LiFT® can deliver fast energy directly to the muscles, like carbohydrates, but with a much higher caloric density. Because of these properties LiFT® can have a significant muscle glycogen sparing effect.

LiFT® leverages all these features by usage of new smartly structured lipids (medium- and long-chain triglycerides or MLCTs). This whitepaper is an attempt to share our knowledge of this highly innovative supplement, so that its potential can be grasped and its use perfectly integrated into current exercise fueling technologies.

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I. Introduction To Lipid Metabolism

Lipids are structured molecules containing 3 fatty acids and a glycerol backbone (hence the name triglycerides). They have a much higher caloric density of 9kcal/g compared to 4kcal/g for carbohydrates and protein. A higher caloric density means more energy is available from one gram of lipids compared to carbohydrates or protein. This should make them the ideal source for fueling exercise. But lipid metabolism is such that energy delivery is slower and longer-lasting compared to carbohydrates.

In order to understand why lipids have not been traditionally used for fueling exercise, a closer look into lipid metabolism is necessary.

A. Post prandial long-chain triglyceride metabolism

Digestion and absorption of fatty acids is affected by the length of their carbon chain. The longer the chain length, the lower the degree of uptake [1]. Long-chain triglycerides (LCTs) are subject to de-esterification in the intestine, resulting in the release of two free long-chain fatty acids (LCFAs) and the formation of an sn-2 monoglyceride. These enter the cells that line the intestine, enterocytes, and once inside, LCFAs and monoglycerides are re-esterified into triglycerides and packed with phospholipids, cholesterol ester, and apolipoproteins into structures called chylomicrons. These chylomicrons are released into the lymphatic system from where they drain into the subclavian vein via the thoracic duct. In this manner, LCTs reach the circulatory system to become available to peripheral tissues and become long-lasting sources of energy.

When these LCFAs reach the peripheral tissues, and muscle cells specifically, they enter the cell via specific transport proteins like CD36 and FATPs (fatty acid transport proteins) and have to build carnitine esters for import into the mitochondrial matrix. So, they need a special transporter to enter the cell and the mitochondria before they can be used as fuel source through a process called β-oxidation. The need for this dual transporter is part of the rate limiting factor that makes LCTs slower as source for fueling exercise.

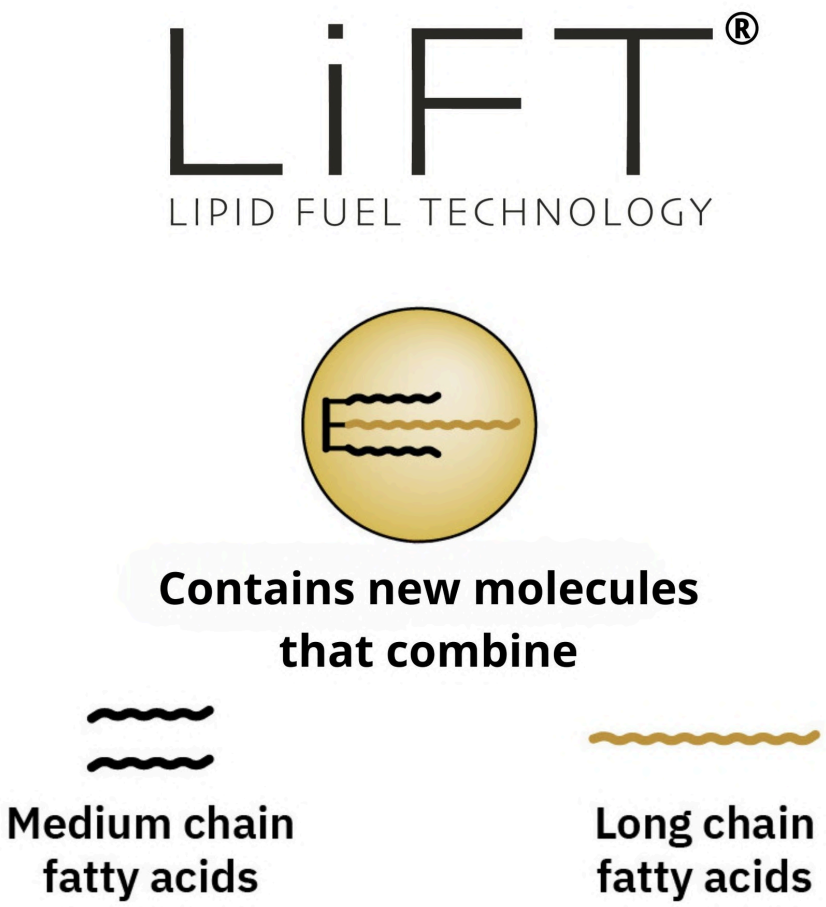
B. Medium chain-triglyceride metabolism

Medium-chain triglycerides (MCTs) are processed in a completely different manner. In the intestine, they are hydrolyzed into free medium-chain fatty acids (MCFAs) and glycerol. MCFAs diffuse into the enterocytes but are, by and large, not re-esterified. Instead, they continue moving by diffusion into the portal vein where they form complexes with albumin. MCFAs bound to albumin are then directly taken up by the liver. In the liver, MCFAs can rapidly diffuse into the mitochondria, where they are catabolized through β-oxidation to become a fast source of energy. A specific transporter is not necessary for MCFAs to diffuse into cells and translocate through the mitochondrial membrane. Most of this energy becomes available either as longer chain fatty acids synthesized in the liver from these MCFAs, or as ketone bodies.

Several studies were done with MCTs for exercise performance. Some showed benefits, others were not able to show benefits. Recently, and on the back of the data showing positive results, supplementation with exogenous ketones have become more popular in endurance sports.

However, on top of inconsistent results, MCTs need conversion into ketone bodies in the liver for them to serve as a source for fueling exercise and this conversion is partially inhibited by the insulin release that occurs when consuming carbohydrates [2,3,4].

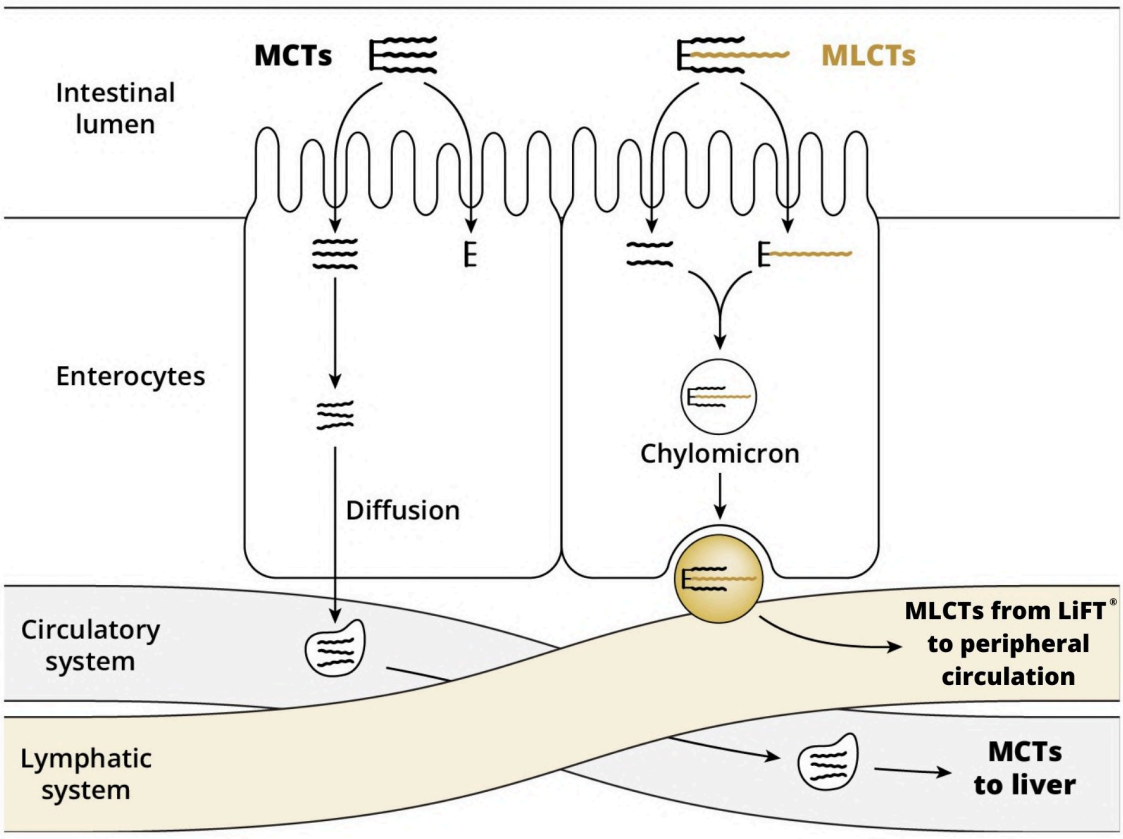
Scientists created a solution that combines the best of LCTs and MCTs and negates the downsides of both. Enter LiFT®.



C. LiFT®: a supplement containing NuliGo® structured MLCTs and their highly specialized metabolism

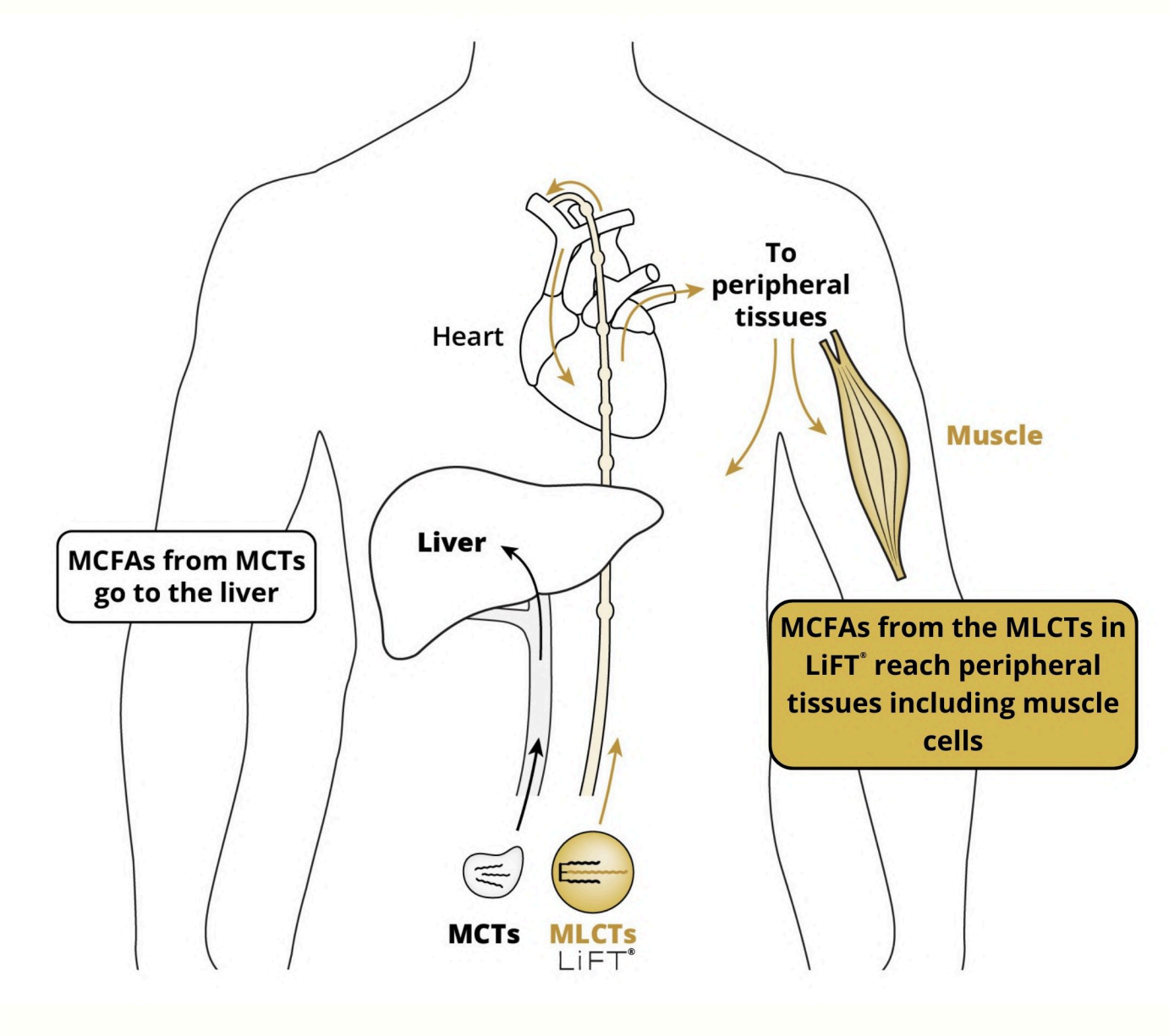
In essence, LiFT® is a lipid solution, based on smartly structured medium- and long-chain triglycerides (NuliGo®), that has the potential to deliver a glycogen sparing effect in endurance performance. This glycogen sparing is crucial for being strong in the last part ("finale") of endurance races like cycling or marathon running. How does LiFT® realize this feat? Before we go into that we first have to explain structured MLCTs.

What are structured MLCTs? Structured MLCTs are the product of interesterification whereby fatty acids of MCTs and LCTs are separated from the glycerol backbone and then recombined to create new structured triglycerides. The newly formed lipid, contains both MCFAs, like caprylic (C8:0) and capric (C10:0) acids, and LCFAs, like oleic (C18:1), linoleic (C18:2), and linolenic (C18:3) acids.



Structured MLCTs combine properties of both MCTs and LCTs. They are de-esterified in the lumen of the intestine and diffuse or get transported into enterocytes as monoglycerides and fatty acids. Inside the enterocyte, the MCFAs, LCFAs, and monoglycerides are mostly re-esterified and follow the chylomicron route to the lymphatic system. These chylomicrons enter the circulation taking MCFAs to peripheral tissues where they can become fast sources of energy while the LCFAs can be stored for use during tissue repair. Remember, MCFAs can deliver fast energy as they do not need a specific transporter to migrate quickly through the mitochondrial membrane.

So, the NuliGo® MLCTs in LiFT® hijack the absorption and distribution mechanism of LCTs, and then benefit from the fast energy potential of MCFAs to fuel muscle cells.



LiFT® is a supplemental lipid that uses long-chain fatty acids absorption and distribution mechanisms for bringing medium-chain fatty acids directly to muscle tissue for fast energy and, hence, a potential glycogen sparing effect.

II. USAGE

As the usage profile differs from traditional carbohydrate supplementation. We will have to dive a little deeper into the science of postprandial lipid absorption in order to clarify the usage profile of LiFT®.

A. Postprandial absorption of lipids in humans – recent insights

In the last decade, two striking and interesting new characteristics of enterocyte-triglyceride processing have been discovered:

- Lipids secreted at the very onset of a meal are those that were consumed in an earlier meal, suggesting the presence of an enterocyte storage pool for triglycerides.
- A cephalic phase release of chylomicron lipoprotein particles tied to oral stimulation by food intake.

This rise in triglycerides that occurs 10-30 min. after the onset of the meal is denoted “the early peak” to separate it from the primary postprandial peak of blood triglycerides which occurs 3-4 h. after meal initiation. This early peak occurs before the absorption of fat from the ongoing meal could have happened, and is more likely when the previous evening's meal was high in fat. Lambert et al. [5] have shown, via utilization of stable isotopes, that 10-12% of triglycerides consumed in the previous evening's meal appear in new chylomicrons, first occurring 15-20 min after the onset of morning food consumption. This observation indicates that the timing of meal triglyceride storage in the intra-enterocyte pool can last for at least 16 h.

Sensory inputs such as sight, smell, taste, and mastication (prior to swallowing) initiate the first phase of pancreatic secretion known as the cephalic phase. The second interesting discovery is connected to that overall cephalic phase response. The early meal-induced rise in chylomicron secretion from enterocytes can occur when fat is only tasted, i.e., not yet fully consumed. The existence of an oral taste sensor for lipids is intriguing and has led to a taste-gut-brain axis hypothesis.

These two new postprandial lipid absorption insights suggest a specific usage profile for LiFT® as a supplement for fueling exercise performance.

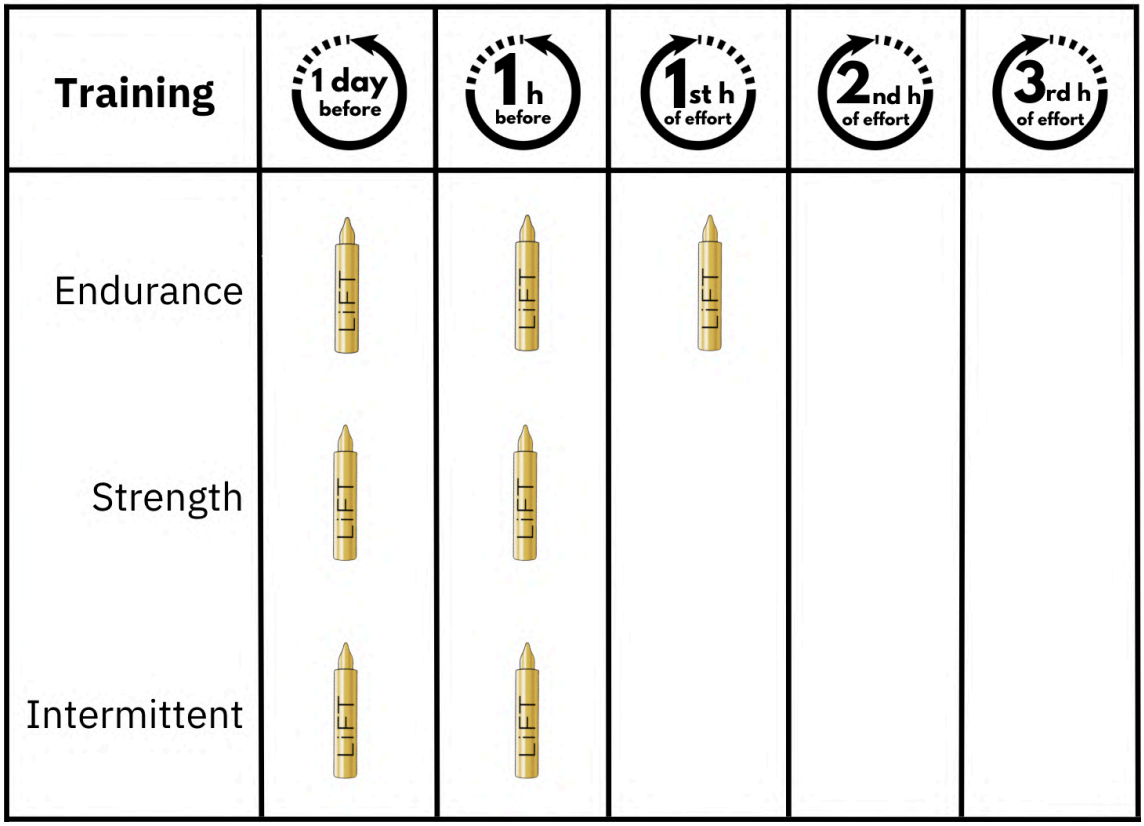
B. Postprandial absorption of lipids in humans – implications for LiFT® usage

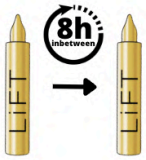
The presence of an enterocyte storage pool for triglycerides, and the cephalic phase release of chylomicrons linked to these stores, imply that preloading of the enterocyte storage pool is necessary for immediate use of NuliGo® lipids from LiFT® during exercise. Furthermore, intramuscular fatty acid composition is influenced by dietary triglyceride intake. Combined, these facts suggest that several days preloading of LiFT® would lead to maximal NuliGo® lipids availability during high-energy, demanding athletic performance. A three-day loading phase is put forward as a strategy consistent with the latest science on postprandial lipid absorption.

Additionally, the use of LiFT® during the initial period of endurance exercise or performance (e.g., first 2 hours) also capitalizes on the cephalic phase response, leading to an initial fast release of chylomicron lipoprotein particles, with preloaded NuliGo® lipids, into the lymphatic system.

The traditional or preferred approach with carbohydrates to fuel performance can be maintained as LiFT® can be added on top of the existing approach with carbohydrates (loading, pre-workout meal/supplement, and certain grams per hour during activity), while keeping total supplemented calories constant.

Below, a user manual for training and/or competition in different types of sports is provided.



Competition	1 day before	1h before	1st h of effort	2nd h of effort	3rd h of effort
Endurance					
Intermittent					

III. LIFT LAB AND FIELD-TESTING RESULTS

A. Lab testing: performance

Three preliminary studies, conducted by a third party, were done with triathletes and cyclists. These are carried out as double-blind, placebo-controlled crossover trials. Double blind implies that the athletes and lab technicians were unaware what they were taking (placebo or LiFT®) and cross over design means that they did a test with both the placebo and in random order, with less than 10 days between the two tests.

These preliminary studies were being conducted with different supplementation protocols. The main goal of this pretesting was to calculate dosage for an upcoming clinical trial with academic partners.

Test protocol: 2h of cycling at 55% FTP followded by a 1h all-out effort on a bike ergometer.

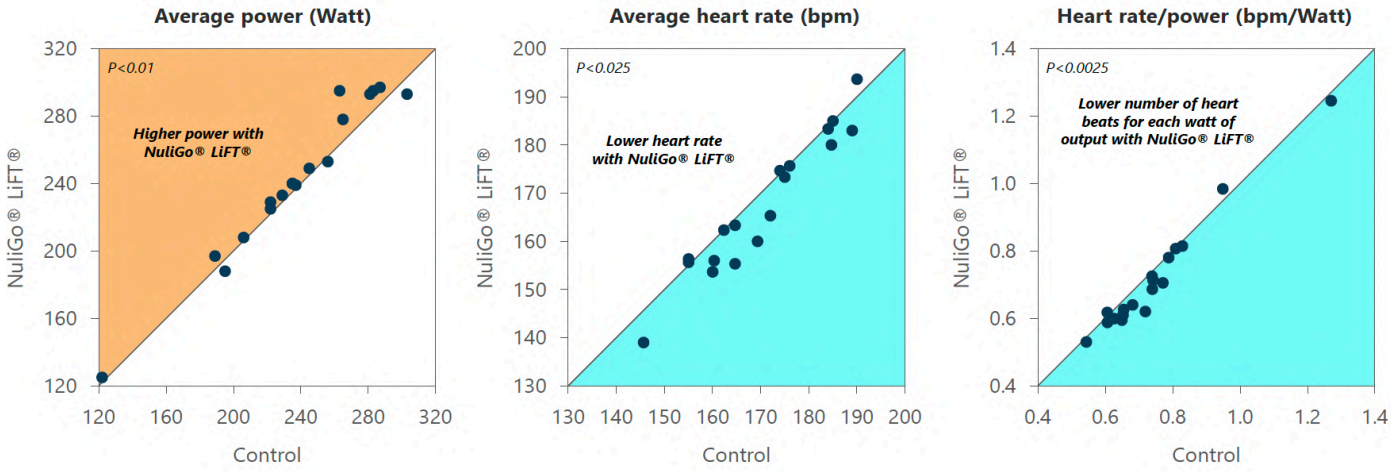
The pretesting results of the total sample group (18 people) in the best performing protocol is showing a **significantly higher power output (5,6 Watt, P<0,01)** during a 1h all-out performance with LiFT®. This improvement was performed at a significantly **lower heart rate (P<0,01)** and **without an increase in lactate levels.** This is a first proof of the mentioned muscle glycogen sparing effect that translates into better performance. During these studies with 2h pre-exhaustion and a 1h all-out performance, some athletes improved their FTP (functional threshold power) up to 15 Watt. A larger ongoing clinical trial is also studying individual differences to the response on LiFT®.

Preliminary results also point our that the carbohydrate sources that is used in combination with LiFT® can have an influence on the performance benefits.

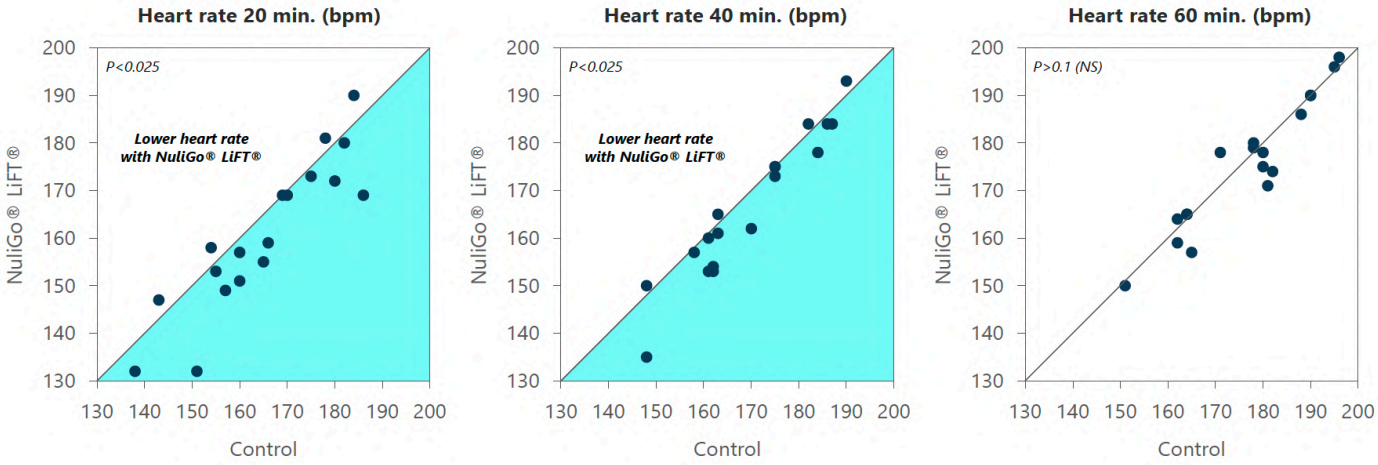
<u>Summary of the results:</u>

The results are encouraging for power output and heart rate, something consistent with athlete's feedback.

- Significantly higher average power output with LiFT® during 1h all-out performance.
  - Median: (+1.7%, p<0.01)
  - Average: (+2,3%, p<0,01)
- 15 out of 18 people had a noticeable effect on power

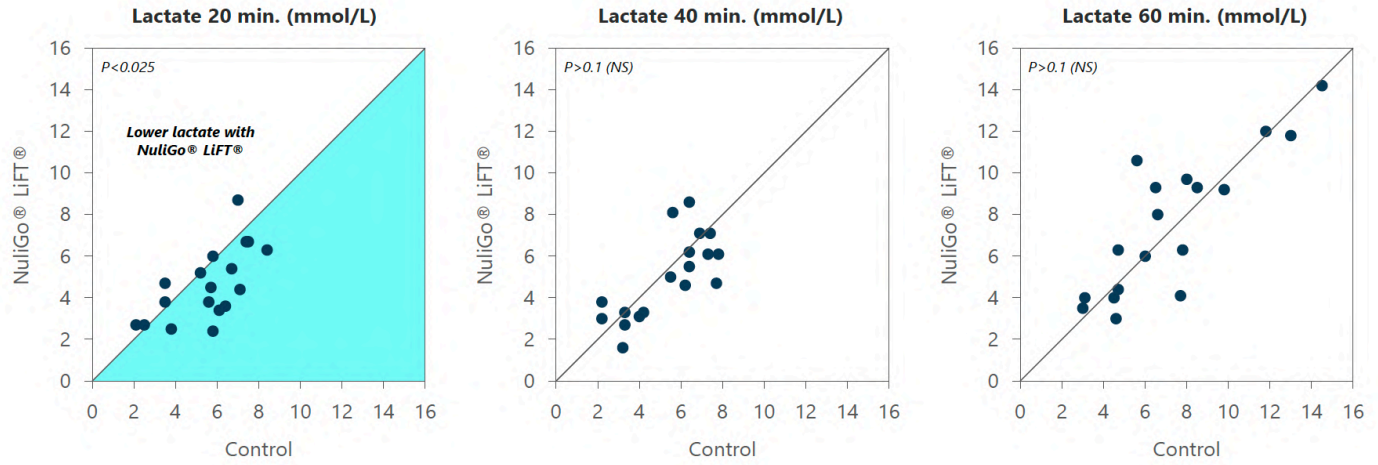


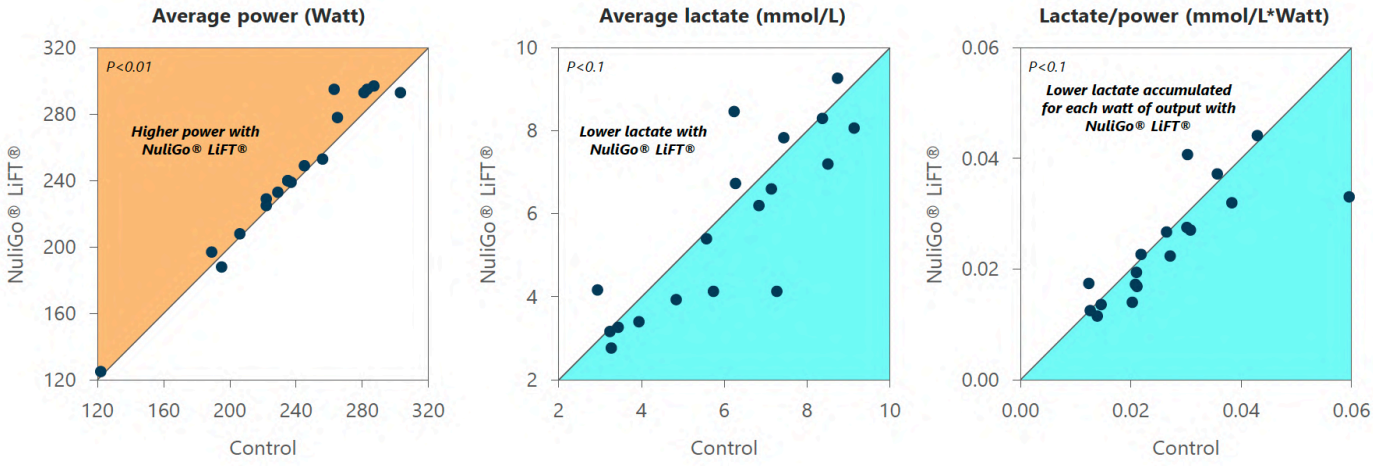
- Strong effect in power-normalized heart rate with LiFT® (-8.9%, p<0.0025)
- Significantly lower average heart rate with LiFT® (-3.7%, p<0.01)
    - The effect on heart rate diminished over time as heart rates go up, likely due to athletes' significantly higher power output with LiFT® and the fact that, towards the end of the trial, athletes are reaching exhaustion with the consequent shift in energy sources away from fat oxidation; this is consistent with the hypothesized mechanism of action for LiFT®.



Lactate accumulation seems reduced with LiFT® early in the time trial (20 min.), but the difference goes away by the end to the time trial; this might be due to the significantly higher power output when the athletes take LiFT®

- Significantly lower lactate accumulation at 20 min. (-24.3%, p<0.025)
- No significant difference at 40 and 60 min. (p>0.1 in both cases) as lactate levels go up
- However, average power-normalized lactate accumulation is lower (-6.7%, p=0.05)





B. Lab testing: recovery

This study investigated the effects of LiFT® structured lipids on muscle recovery after exercise-induced muscle damage. It was a double-blind, randomized, placebo-controlled study involving 38 healthy, recreationally active women (ages 18–35) who were non-smokers. Participants were divided into two groups: The LiFT® group received 9ml of LiFT®, the placebo group received a mix of canola and MCT oil to mimic LiFT® oil.

The test **protocol** consisted of baseline testing, a muscle-damaging exercise and an immediate post-exercise testing. Follow-up testing was done 24, 48 and 72 hours after exercise.

- Baseline testing:
  - Muscle performance: during eccentric knee extension, torque was measured with isokinetic dynamometry.
  - Vertical jump performance: power (in watts) and velocity (in m/s), during a counter-movement vertical jump, measured with a linear transducer attached to the subject's waist.
- Muscle-damaging exercise: 8 sets of 10 eccentric knee extensions on a leg extension machine.
- Immediate post-exercise testing: the same muscle performance and vertical jump performance of the baseline testing.

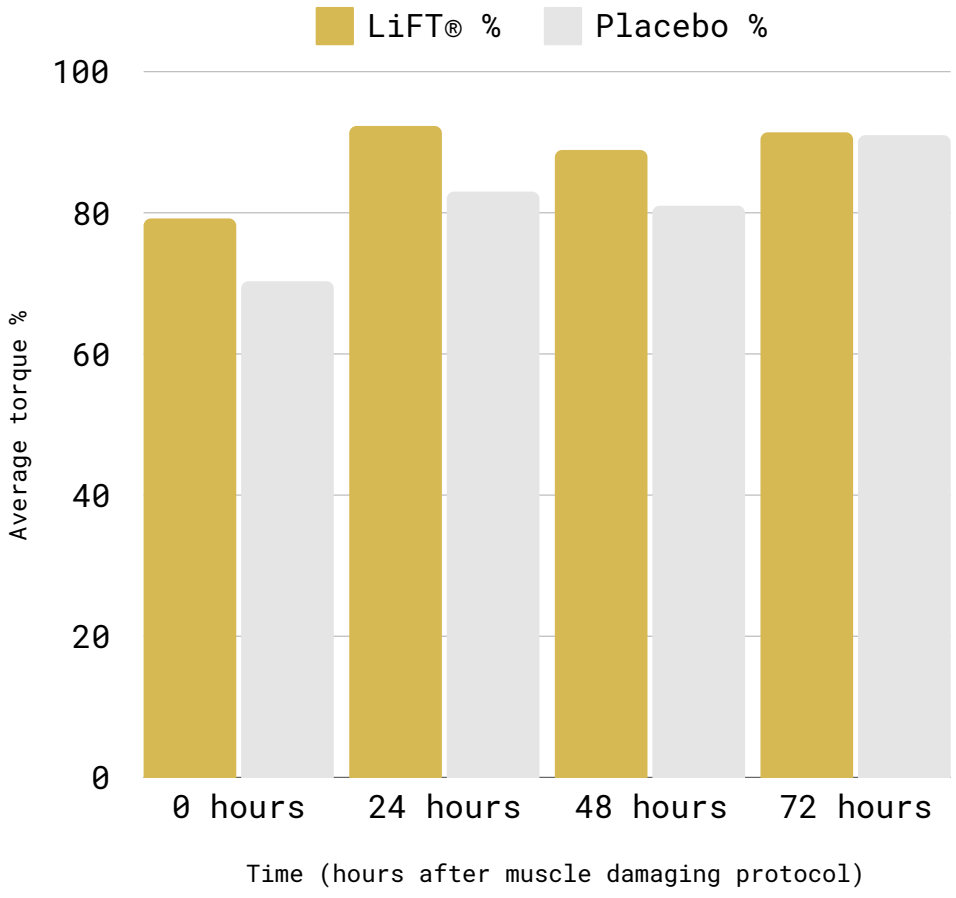
Results: Baseline-normalized data showed that subjects in the LiFT® Group experienced a significantly lower reduction in torque after the muscle-damaging protocol than those in the Placebo Group. These results suggest that LiFT® sMLCTs may help mitigate muscle damage during strenuous exercise. Average torque decrease after muscle damage:

- Placebo Group: -29.7% (or 70.3% of baseline; $p<0.0000005$)
- LiFT® Group: -20.8% (or 79.2% of baseline; $p<0.0001$)
- 30% lower reduction in torque in the LiFT® Group ($p<0.05$, t-test)

At 24, 48, and 72 hours post muscle-damaging exercise, subjects in the LiFT® group showed a non-significant reduction in torque compared to baseline. On the other hand, the Placebo Group continued to show a significant decrease in torque that only became statistically indistinguishable from the baseline after 72 hours.

- 24hr:
  - LiFT® group: -7.7% (or 92.3% of baseline, not significant)
  - Placebo group: -17.0% (or 83.0% of baseline; $p<0.00005$)
- 48hr:
  - LiFT® group: -11.1% (or 88.9% of baseline, not significant)
  - Placebo group: -18.9% (or 81.1% of baseline; $p<0.0005$[9])
- 72hr:
  - LiFT® group: -8.6% (or 91.4% of baseline, not significant)
  - Placebo group: -8.5% (or 91.5% of baseline, not significant)

These results indicate that, besides the performance enhancing effects of LiFT®, there is also a positive effect on muscle damage and so recovery. These mechanisms could enable athletes to cope with higher 'work load capacity' and could result in better performance.



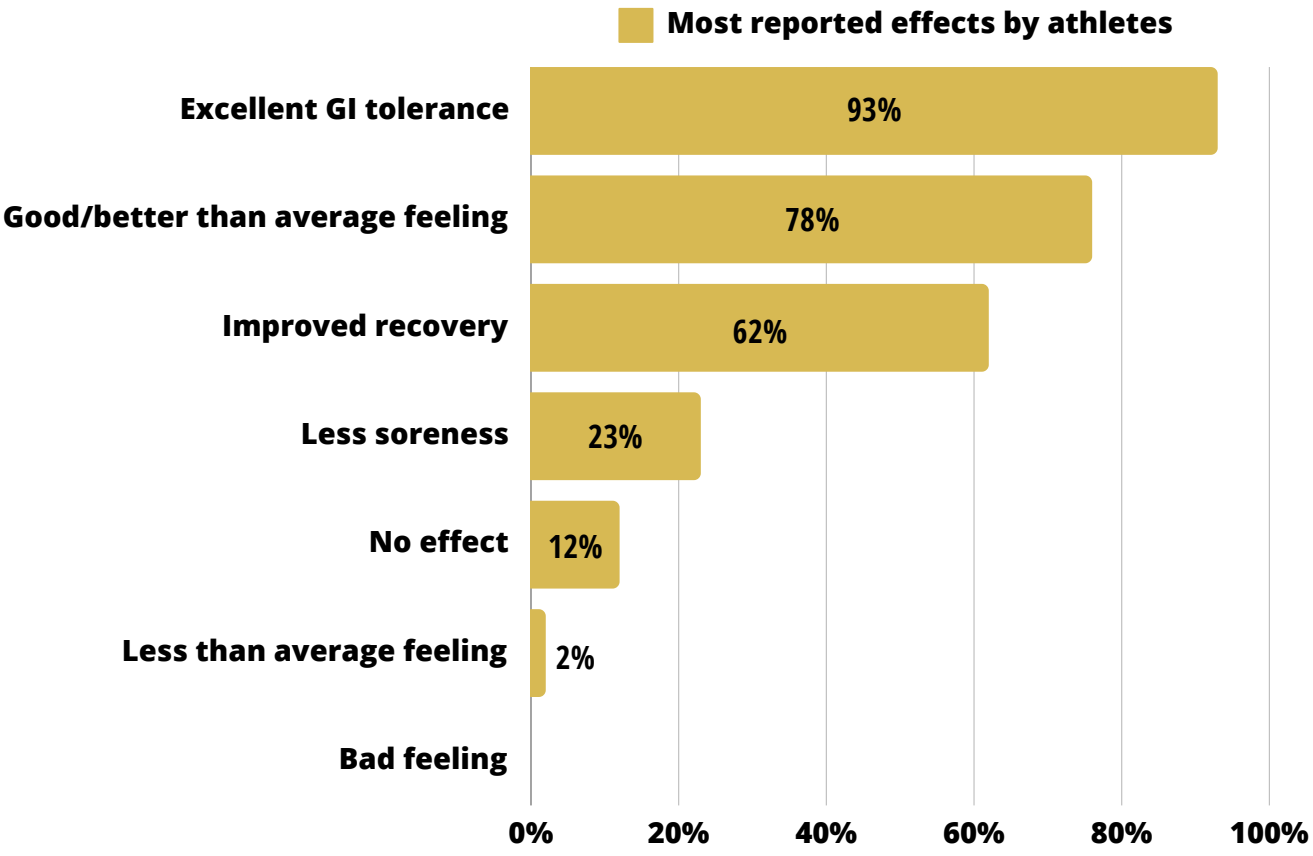
LiFT resulted in 30% less muscle damage leading to earlier recovery.

C. Field testing

Many athletes in different kinds of (extreme) endurance and interval-specific sports have been rigorously and thoroughly testing LiFT® for an extensive period. All athletes that participated in our field tests were unaware of the possible or expected effects of LiFT® in order to minimize a possible placebo effect.

Some key elements from the outcome of all this field testing:

- Cycling: 24 of 30 tested cyclists reported having “good legs” that day and 5 reported having “extremely good” legs. 28 cyclists reported excellent GI tolerance and no side effects.
- Triathletes: 5 of 6 reported feeling fresher after long training. All reported excellent GI tolerance as well.
- Ultra runners: 4 of 6 reported better than average feeling.
- Motocross: 4 of 5 reported less arm pump.
- Strength training: 2 of 3 athletes reported a better feeling during strength training



IIII. FEEDBACK OF REAL CUSTOMERS

★★★★★ 19/08/2023

Eric E. Verified Buyer

Belgium

LIFT during ultra-trailrun

Last weekend used LIFT for the first time during an ultra-trail run (80km / 2400 d+ in 8h35'). In consultation with 4Gold, applied LIFT in combination with my carbohydrate intake for best results. Remarkably, I did not notice a 'drain' of energy towards the end of the race. I also experienced significantly less muscle pain in the quadriceps and calves in the days after the race, which is probably due to the fact that I was able to conserve muscle glycogen.
No stomach problems noted.
Easy to carry, easy to open and a fresh (slightly oily) aftertaste with a taste of citrus (lime).
Definitely recommended for prolonged efforts like trail/ultratrail. I will definitely continue to use the product in future ultra-trailrun races.

★★★★★ 06/05/2024

Ben S. Verified Buyer

United States

Endless endurance

It really seems to work. I've used this a few times on longer, harder rides. Where I'd usually start to feel "empty" on power towards the end, there's still response from my legs when asked to push. Tastes great and is easy to open 1-handed while riding too.

★★★★★ 22/01/2024

Nrtopj

France

Amazing performances

Tested the product on 3 days with pro cycling team and it was amazing I had no fatigue at all after 5 hours on the bike with a lot of intensity.
With a good nutrition on the bike it's a wining product

★★★★★ 15/02/2024

Marcus G. Verified Buyer

United States

Very promising

I have just used this on a few rides and am still experimenting, but so far I like how this compares to carb-based on-the-bike energy food / race food. The energy it gives you is closer to a I-ate-a-light-meal 2 hours ago buzz, than a sugar boost. So, it's less speedy, and feels like 'deeper' energy. I also feel like it reduces muscle soreness at high efforts. What I still have to test is extremely long all-day efforts, most of my tests so far have been in the 2-4 hour range.

★★★★★ 14/08/2023

DENNIS K. Verified Buyer

Netherlands

Awesome 👌

It was the first time I used them on an ultra trail. I didn't expect it to give such a boost every hour. I've done 70 km with it and really I'm a fan! Also because it is small and therefore easy to carry.

★★★★★ 27/09/2023

Cathy S. Verified Buyer

Belgium

LIFT lifted me

I am preparing myself for the Marathon of Antwerp on the 22nd of october. I use LIFT on my long-distance trainings since 2 weeks . The overall feeling is better, I run faster and can keep my pace easier. It feels like you have more power and that gives me the right mindset to reach my goal ...

★★★★★ 05/03/2024

Sander B. Verified Buyer

Belgium

Handy and effective

Having some experience with keto and lipid based fueling for ultra trail running, I immediately recognized the effect during some first test on a very long slow trail run. Steady energy, even without any additional carb intake. Easy on the stomach too. Back for more!

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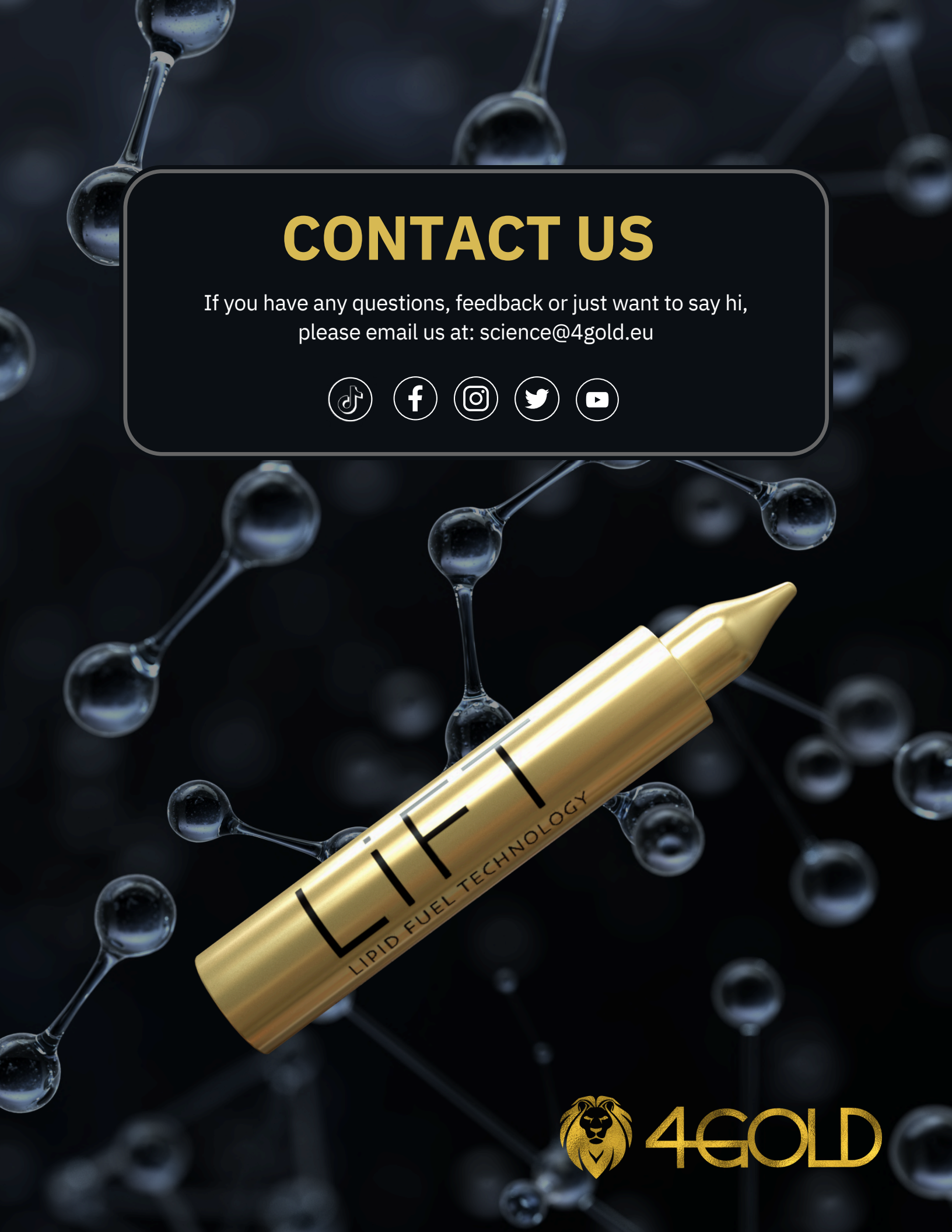
THE PARTNERSHIP BEHIND LiFT®

LiFT® is a revolutionary creation resulting from the synergistic partnership between 4GOLD and Bunge Nutrition, a global leader in nutritional lipids.

Together, they leveraged the latest science in lipid metabolism and focused it in athletic performance and endurance. LiFT® is the result of extensive research and development driven by a passion for innovation.

CONTACT US

If you have any questions, feedback or just want to say hi,
please email us at: science@4gold.eu



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