GREYSILO VENTURES
POSITION PAPER 01

FAT REVOLUTION IS COMING

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Grey Silo Ventures: Position Papers

Dear Reader,
Welcome to the first Position Paper of Grey Silo Ventures.
The food-tech industry is growing at an incredible rate: new technologies, business models, and startups are continuously joining the stage to solve the most complex problems related to the many aspects of this sector: nutrition, sustainability, human rights, and so on.

With such a high rate of innovation, deal flow generation, sourcing, and screening have become harder to manage and cope with and require up-to-date information about the many facets of the industry.
GSV Position Papers strive to fill this gap, providing relevant content and insightful views on the industry.

We are pleased to publish our Position Paper I, exploring the many aspects of one of the main components of human nutrition: fats. Indeed fats innovation is an emerging trend that has gained much attention from the corporate world and the venture industry: a new territory to explore.

Enjoy the reading!

How to cite this Position Paper

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01

Some key facts about fats

Since the earliest civilizations, fats, and oils (liquid fats) have played a role in the history of humankind. This reflects their biological importance and role in life. Fats and oils belong to the bigger group of lipids, where we can also find the well-known molecules cholesterol and phospholipids. Both are key constituents of the cellular membrane. Phospholipids, by the way, are industrially recovered for their role as emulsifiers in food, and commercially better known as lecithins, widely used in chocolate making, among other uses.
Fats and oils both share the same general structure. They have three “tails” made of fatty acid linked to one molecule of glycerol, and for that reason are called "triglycerides" by chemists. Those tails are responsible for the triglyceride being an oil or a fat (liquid or solid at room temperature). We know today that tails carrying one (unsaturated) or more (polyunsaturated) double links among carbon atoms in the tail are generally good for human health, and liquid at room temperature, whereas saturated fatty acid (only single links among carbon atoms) gives solid fats at room temperature and generally recognize to have bad impacts on cardiovascular health.

Fats and oils have been in use since Mesopotamia and ancient Egypt, dating back to 6000 years ago. In ancient Egypt, a broad range of fats and oils was exploited, not only for food, but also for cosmetics: linseed, olive oil, and even palm and cedar, and fish, crocodile, or hippopotamus among animal-based ones.
In the Americas, the usage, and consumption of avocados fruits, which for their composition might be called “vegetable butter”, dates to almost 10,000 years ago in the area of current Mexico. Among the oldest fats of animal origin is butter, whose consumption also dates back to 9,000 years ago, closely linked to animal domestication, and ruminants in particular: cows, of course, but even sheep and goats, camels in Africa, reindeer in the Nordics, and buffalos in the planes of North America.
Greeks and Romans widely developed the crushing technique of olives, obtaining oil exported everywhere along Mediterranean

routes. Used for food, as a balm in sports and cosmetics, and even as a light source, olive oil permeated the Roman empire. A rough estimation points to a production of 30 million liters of oil per year during the Roman times.

During the Middle Ages and Renaissance period, the kind of fats and oils available didn't change a lot compared with Roman times. What changed was instead production and availability, with a steep decline in olive oil production and clear growth of fats from animal sources, especially in areas far away from the Mediterranean coast.
However, in the 17th Century a key innovation in the fat world, soap making, took place, widening the applications and usage of fats. The well-known "Marseille soap", is traditionally made by the union of seawater, olive oil, and the alkaline chemicals soda ash and lye.

Later, the advancement of chemical knowledge led to the development of novel industrial uses for fats, and this went hand in hand with the research of new sources in nature. This is when men started hunting the toothed whales for their spermaceti, the waxy and oily substance that filled in their heads.
This was an appealing product in the nineteenth century: in its liquid form it was used to fuel lamps, while in its congealed form, it was used for candles and soaps.
The whales-hunt ceased at the end of the century, as the number of whales drastically decreased.

Nowadays, the interest has shifted towards polyunsaturated fatty acids, for their beneficial properties in human health, while fatty acids are being used as a green source for biofuels and feedstock production.

02

Fat revolution: why now?

To date, the majority of companies operating in the non-animal-based space have focused mainly on replicating animal protein with other forms of non-animal protein sources -with *Beyond Meat* and *Impossible Foods* being the forerunners back in the late '00s, rapidly followed by a plethora of companies.

In this area, different technologies have been tested and adopted: plant-based texturized proteins, precision fermentation technologies, or exploiting the potential of fungi/mycelium. However, proteins are only part of the nutrients coming from animal sources needing a replacement.
Fats are another, unexploited, green field for new technologies and start-ups.

While fat typically comprises a smaller fraction of total meat content (the majority of biomass in common meat products is muscle cells), it is a key determinant of flavor, texture, nutrition, and visual appearance, all of which are correlated with consumer preference and willingness to pay.[1]
Moreover, as with alt-meats in general, start-ups are exploring the use of cell-cultured or fermented fat cells along with plant-based protein may thus significantly improve the quality and consumer perception of plant-based meats without compromising sustainability.

The alt-fat start-ups are not only addressing the availability of the current vegetable fats used in meat analogs.
For instance, most plant-based burgers feature coconut oil as their key fat ingredient, mainly for its high content of saturated fatty acid which makes it solid at room temperature. Coconut oil only represents roughly 2.5% of the World's vegetable oil production, with two Countries, the Philippines and Indonesia

accounting alone for 70% of coconut oil production.[2] With an increasing demand for coconut oil and a 5.4% CAGR forecasted (2022-2032), coconut oil availability represents an incumbent need.[3]
According to the article[4] drawn up by the Good Food Institute, coconut oil is currently the leading vegetable fat used in meat alternative products because it has a better semi-solid structure than other vegetable fats. The article also estimates that by 2030 the meat alternatives industry will require about 13% of global coconut oil production, questioning the long-term availability and sustainability of this product.

The other growing area of fat replacement is linked to the replacement of cream and milk-derived fats (i.e., butter). The potential here is huge as this will cover the market of bakery products, salty and sweet products alike.
Today, despite the large usage of vegetable fats instead of butter, no one could yet replace the texture and smoothness conferred by real butter.[5] This is a simple and focused pain-point of the industry (and the customers) only waiting for the right solution.

Last and not least, palm oil replacement. Refined palm oil is indeed an incredible ingredient, whose spreading in the Western food industry was as late as the 1920' and, since then, became almost irreplaceable. Refined palm oil, odorless and colorless, is semi-solid at room temperature, because half-saturated. Therefore "it can fry like lard, bake like butter, melt like chocolate, and whip like cream at a fraction of the cost", with productivity much higher than any other vegetable oil on the planet.[6]

Not surprisingly, the industrial history of palm oil is linked to giant corporations such as Unilever. The spreading of palm oil was further pushed by legislation limiting in many Countries

the usage of partially hydrogenated oils. Partially hydrogenated oils can indeed achieve a melting profile similar to the one of palm oil but are rich in trans-fatty acids, which harm human health since associated with coronary heart disease.[7]

Despite its benefits, today palm oil usage is under discussion in many Countries and affected by negative media coverage (e.g., in France and Norway) partly because the amount of saturated fatty acids is higher than in liquid oils (saturated fatty acids are an additional health issue) but, mostly, because of the environmental impact of palm oil cultivation on biodiversity.[8]

Palm oil production accounts for 35% of all vegetable oil produced globally using less than 10% of the land allocated to oil crops. However, it happens that this land is mostly in the equatorial regions, where the equatorial forests, among the richest ecosystems in biodiversity, are threatened by palm oil cultivation. Therefore, palm oil production offers a still unsolved conundrum awaiting ground-breaking solutions.

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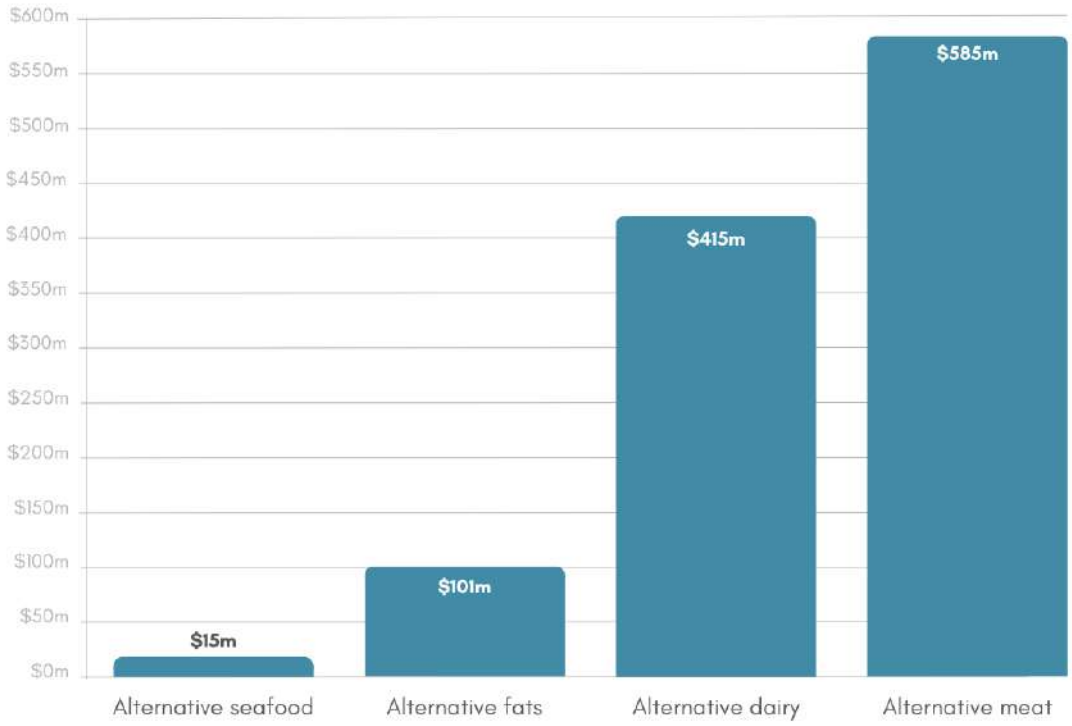
Which potential?

Because of the increasing knowledge of the different health benefits of fat replacers and alternatives, the category show growth potential for the future. Consumers are increasingly questioning the impact of saturated fats on health, looking for alternatives to their low-calories or plant-based diets, and tackling at the same time worldwide health issues such as obesity or other health-related diseases. .

Therefore, the fat replacers and alternatives market is driven by consumers 'increasing awareness of health issues, leading them to change their eating habits towards healthier diets". According to the market research drawn up by Allied Market Research,[9] the global fat and oil market size in 2021 was $236.7 billion, with the butter market representing 22% ($51.6 billion)[10] and the palm oil market representing the 27% ($63.7 billion)[11] of the total market size. As a growing category, the global fat replacers market size was valued at $3.3 billion in 2021, with an estimated growth of $6.4 billion by 2031 (CAGR 6.4%).[12] Based on the abovementioned figures, even without considering the forecasted growth in this area, ground-breaking solutions aiming at replacing as less as 5% of the butter and palm oil market will have a market potential of 2.6 and 3.2 billion respectively, at a global level.

With such encouraging market potential, it is no wonder that funding in the space has started to keep up with the pace, as highlighted by the graph below (courtesy of Sifted and Dealroom). Today, the absolute value of European VC investments in the alt-fat space is lower compared to the alt-prot one being relatively small (every dollar invested in alt-fats amounted to around 6 invested in alt-proteins).
However, we believe that alt fats companies will experience strong growth in the upcoming years, both in terms of funding received and commercial appeal.

Funding for European alternative protein startups ($m), 2015-2022



Source: Dealroom

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Who's who in the fat world

The array of companies producing fats from alternative sources (we do not want to claim non-animal, as cultured fats still rely on animal cells to create the final product) can be ultimately categorized by (i) the chemical profile of the produced fat and (ii) the technology applied to produce such fats. The focus of this paper is to identify the key technologies currently exploited to produce alternative fats.

Plant-based fat extraction

This technology directly refers to methods and applications used to extract fat cells directly from plants, mainly through a mechanical process combined with a chemical process.
Two good examples of this technology are **Time Travelling Milkman**'s oleosomes (molecules that are naturally present in oilseeds such as sunflower) to extract fat droplets and recreate creams and oils and **Lypid**'s PhytoFat.

Pros

- Cost and resource-efficient
- Scalable
- Short time-to-market

Cons

- Off-taste limits the array of applications

We spoke with **Dimitris Karefyllakis**, founder and CEO of **Time Travelling Milkman**, to get his take on plant-based fat extraction technologies and their unique value proposition: "*We see our alternative fats as an easily up-scalable ready-to-marketed technology. Precision fermentation and cultivation of fats is a very interesting but long shot that won't tackle the burning issues of mouthfeel and texture that plant-based product manufacturers face today*".

Biomass fermentation

According to GFI, "Biomass fermentation leverages the fast growth and high protein content of many microorganisms to efficiently produce large quantities of protein." Companies in this space are trying to engineer their strains of yeasts and microorganisms to then feed with different sources of sugar to let them grow and extract fats.

A good example of this technology is the one used by **NoPalm Ingredients**, a Dutch company that has developed a proprietary strain of yeasts that yields a fat molecule that resembles the different fractions of palm oil.

Pros

- Non-GMO
- Final products have a similar chemical profile to the animal counterpart

Cons

- Limited array of applications for the final products

Lars Langhout, founder, and CEO of **NoPalm Ingredients** believes that palm oil's taste and chemical profile needs to be replicated as quickly as possible: "*with our tuneable fermented oils and fats, we can tailor the fatty acid profile, according to the companies we work with to provide the exact functionality they need, which is currently sometimes not even possible. Fermentation-based technologies will reach the market sooner than cultivated fats that will go through the same legislative and scaling issues as cultivated meats are undergoing at the moment*".

Precision fermentation

This technology refers to encoding specific DNA sequences into micro-organisms, like yeast or fungi, fermenting them with nutrients and sugars (upstream process) in fermentation tanks to allow cell proliferation, and then extracting the specific cells needed (downstream process).
This tech allows for exact replication of the required animal-like fat molecules and it is therefore being explored by many companies worldwide.

Pros

- Chemical composition of the final product is equivalent to their animal counterpart

Cons

- Long regulatory path (GMO products)
- Scalability (due to high downstream costs)

Sun bear Bioworks, a company from the UK is tackling the oil issue using a very specific approach. According to **Ben Wildling**, co-founder and CEO of Sun Bear Bioworks, the company "*is looking at new and innovative ways to produce an alternative to palm oil, which will greatly reduce the downstream processing complexity and costs, thus making its product more commercially viable and simpler to work with*". The founding team brings both science and technology together and through the use of AI and machine learning the R&D cycles are quicker and more effective.

Carbon capture fermentation

This is a very specific form of biomass fermentation, which replaces the use of sugar-rich feedstock with CO2. Companies in this space use proprietary microbes and processes to make designer fats for any food. A company in this space is Hamburg-based **Colipi**.

The company produces oils from industrial side streams, through natural fermentation by putting wild-type yeast cells to work. The specificity of their approach is that they incorporate proprietary carbon capture and utilization (CCU) solutions to enhance production.

Pros

- Upcycling CO2 as an additional revenue stream
- Resource-efficient approach

Cons

- Limited array of applications
- Scalability

Cellular agriculture

Cultured meat (CM), also known as cell-based, lab-grown or cultivated meat, is created from animal cells cultured in the laboratory using tissue engineering technology.[13] CM can fundamentally change the global meat production marked by providing a more ethical and sustainable alternative to conventional processes.
Through cell cultures, fats are produced by culturing one or more animal cells, which, through growth in a controlled environment, can reach a substantial critical mass. By setting different parameters for their growth, these cells are adapted to develop as the fat that is needed to be replicated.

Pros

- Chemical composition of the final product is equivalent to their animal counterpart
- Minimal use of resources compared to animal production

Cons

- Scalability (cost-intensive)
- Controlling regulatory pathway

A company specializing in the production of cultivated fats is Barcelona-based Cubiq Foods: **CUBIQ FOODS** is developing a Cell-based Omega-3 production process, based on duck cells. These cells can accumulate up to 85% of their weight in oil: by precisely selecting their growth conditions, we attain high-quality Omega-3-rich oils at a competitive cost. Andres Montefeltro, CEO, and co-founder claims that their cell culture system does not use animal serum, and the cost of their culture medium has reduced tenfold since they began.

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Conclusion

At GSV we believe that today, the alt-fat sector is where the alt-protein sector was around 10 years ago: both the number of companies and the amount of funding received by those companies are still relatively small compared to those operating in the alt-protein space.

According to our database, hundreds of companies are developing alternative proteins, but only around 20 are working on alternative fats.

This, together with the importance of lipids from both a nutritional point of view and as a functional ingredient, will make the alternative fat industry a sector to monitor closely in the upcoming years.

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About the contributors

The mission of Grey Silo Ventures, the Corporate Venture Capital of Cereal Docks Group established to invest in the supply chain of non-animal-based ingredients and related innovative technologies, is to broaden horizons in the global food-tech sector while maintaining the original vocation as a processor of plant based sources and explorer of new opportunities for innovation and business diversification.
Grey Silo Ventures is committed to study the great potential of new fermentation processes and innovative green proteins, by using them to create novel ingredients. The ag-tech world and cellular agriculture represent other areas of interest that are part of the value chain in which Cereal Docks Group operates.

Cereal Docks is an Italian industrial group headquartered in Camisano Vicentino (Vi), active since 1983 in the first agro-food processing for the production of ingredients destined for applications in the feed, food, pharma, cosmetic and technical use sectors. Today, the Cereal Docks Group employs more than 250 people in ten different facilities.
In addition to consolidation of its core business, the Cereal Docks Group is also committed to new development focused on transforming the concept of diet to that of nutrition. The development of solutions that guarantee the correct balance of nutritional principles in a context defined by quality, safety, standardization and environmental sustainability is central for offering better responses to health and wellness needs.

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