

NEW TECHNOLOGIES TO IMPROVE THE MICRONUTRIENT STATUS OF TARGETED POPULATIONS

***IFST SPRING CONFERENCE, UNIVERSITY OF BIRMINGHAM, UK
APRIL 4TH 2019***

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PROGRAMME

- Introduction
- Activity Trackers
- How to use technology to increase the global supply of marine omega 3 fatty acids when the world fish oil stocks are declining - the Veramaris project.
- Determination of Macular Pigment Optical Density (MPOD) by optometrists in the high street and remedial supplementation of lutein/zeaxanthin - the Macuwell™ project
- How Personalised nutrition is becoming a reality in the market place

ACTIVITY TRACKERS

ACTIVITY TRACKERS



- Activity trackers are now in widespread use to measure personal fitness, well-being and sleep patterns.
- Activity trackers are now used in clinical trials. In 2012, Van Remortel et al. carried out a systematic review on how activity trackers can be used to provide useful biometric measurements in patients suffering chronic disease (Int J Behav Nutr Phy Activ 2012; 9(84).
- More recently it has been shown they can be successfully used to assess the fitness status of adolescent Australians (Ridgers ND et al., 2018, JMIR Nhealth Uhealth: 6(4): e86).
- Kooiman TJM et al, used them to determine the effect of type 2 diabetes on mobility (2018, Computers, Informatics, Nursing; 36(7): 340-349.).
- It therefore makes perfect sense to use biomarkers derived from activity trackers to measure directly benefits of micronutrients which are thought to improve mobility and fitness (e.g. Vitamin D, glucosamine, marine omega 3 fatty acids).

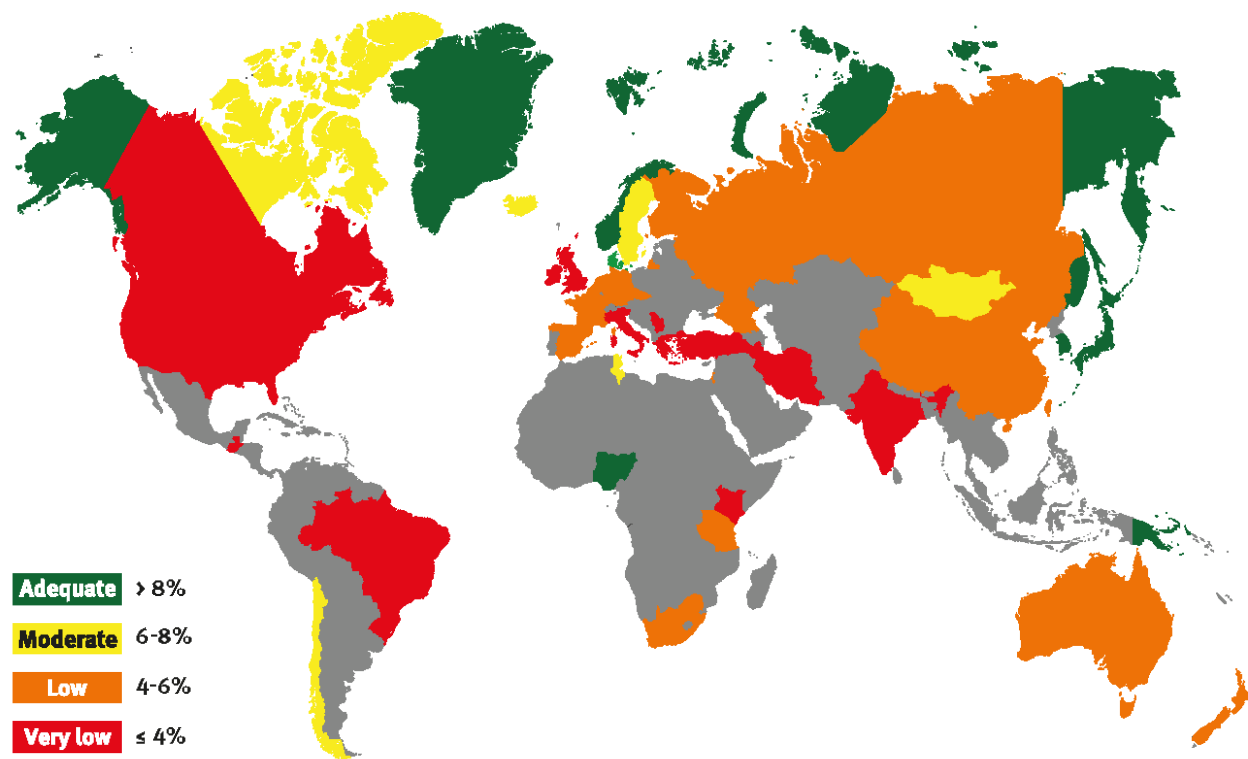


THE VERAMARIS PROJECT

**HOW TO SUSTAINABLY MEET
THE INCREASING GLOBAL
DEMAND FOR MARINE OMEGA
3'S WHEN FISH STOCKS ARE
IN DECLINE**



GLOBAL OMEGA-3 STATUS MAP SHOWS LOW LEVELS FOR MOST OF THE WORLD



Low omega-3 levels are widespread – particularly in the Western World.

Coastal regions of countries and populations that traditionally rely on hunting, fishing and gathering for sustenance tend to have moderate to adequate omega-3 levels.

References: Ref. Stark et al., Global survey of the omega-3 fatty acids, docosahexaenoic acid and eicosapentaenoic acid in the blood stream of healthy adults, Progress in Lipid Research, 20 May 2016; doi: 10.1016/j.plipres.2016.05.001. www.sciencedirect.com/science/article/pii/S0163782715300333.

VERAMARIS AIM TO PROVIDE SUPPLY SECURITY FOR EPA AND DHA OMEGA-3



- Specialist for the cultivation of marine organisms including algae
- Biotechnology capabilities in development and operations
- Specialist in developing industrial biotechnology processes
- Know-how in operating competitively large scale manufacturing sites for fermentative amino acids.

- DSM and Evonik are both long term partners of the salmon feed industry.
- Decades of experience in algal technology and large scale fermentation.
- Commitment to the aquaculture industry: 200 mio USD investment in the new Veramaris algal oil fermentation and production facility
- Commercial capacity (from 2019) onwards: 15 % EPA + DHA annual supply requirement of the salmon industry.

CURRENTLY, LIMITED WILD FISH STOCKS ARE USED ON AN INDUSTRIAL SCALE TO PRODUCE FISH OIL AND FISHMEAL



Anchovy



Menhaden



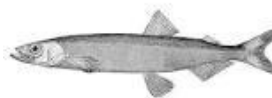
Sprat



Blue Whiting



Herring



Sand eel

16,000,000 tons wild fish



~17% of global wild catch is consumed for the production of fish oil and fishmeal



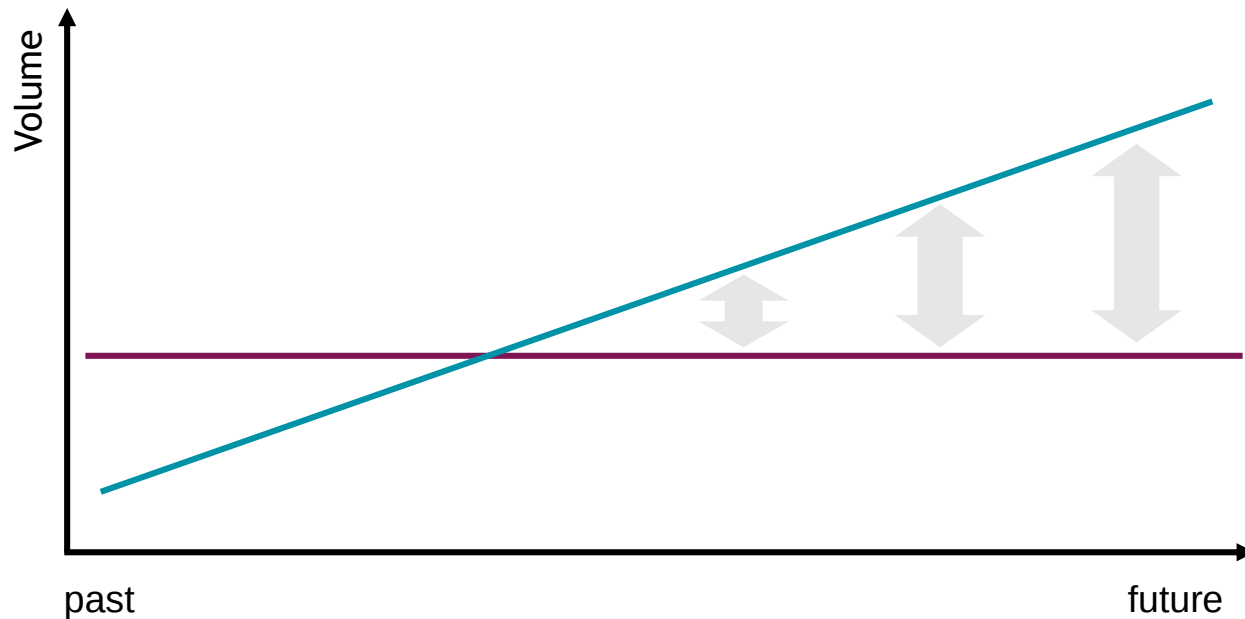
~ 5 million tonnes fishmeal



~ 900k tonnes fish oil

LOOMING EPA+DHA SUPPLY GAP: THE TRADITIONAL SUPPLY OF OMEGA-3 FROM FISH OIL WILL LIMIT THE GROWTH OF THE AQUACULTURE INDUSTRY

- Market supply demand for omega-3



- Meeting the demand for omega-3 fatty acids by utilizing new and sustainable sources of EPA + DHA in the future.

1. Supply: Approximately 900k tonnes per year

- limited supply of fish oil as source of omega-3 fatty acids

2. Demand: Increasing demand for EPA+DHA

- Aquaculture industry growth and EPA+DHA biological requirement
- Consumer demand for omega-3's and healthy nutrition

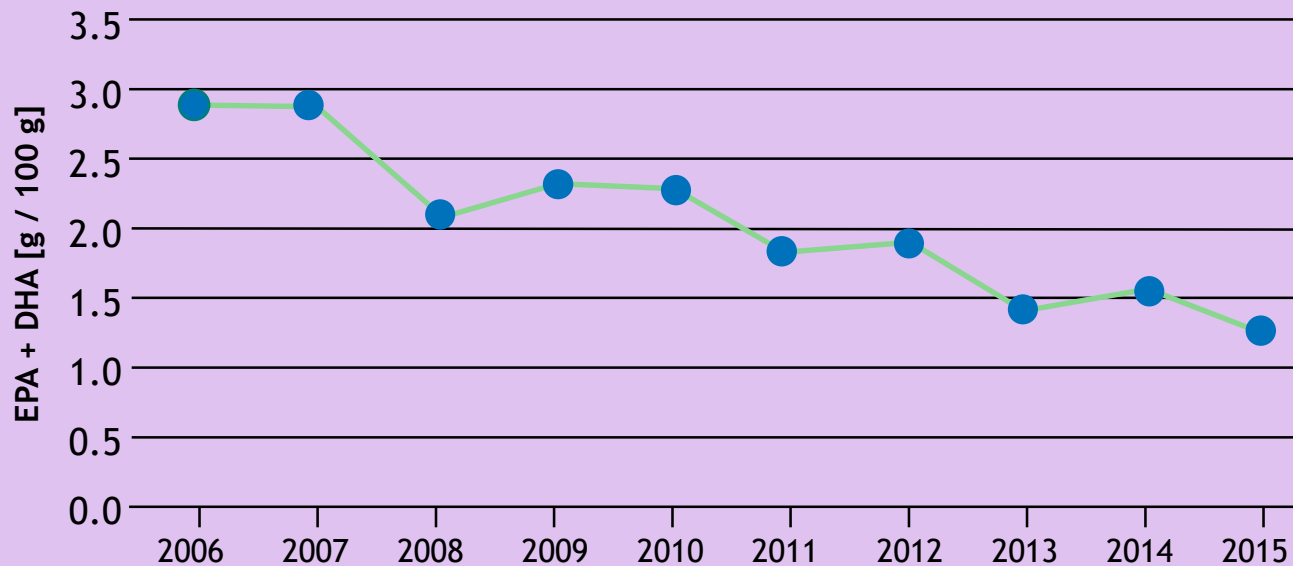
3. Supply-demand gap

- EPA+DHA supply gap will emerge in the near future



POTENTIAL DECREASE IN VALUE OF SALMON FILET: THE OMEGA-3 LEVELS IN FARMED SALMON HALVED DURING THE LAST DECADE

Levels of EPA + DHA in farmed Scottish Atlantic salmon
between 2006 and 2015



Source: Sprague, M. et al. Impact of sustainable feeds on omega-3 long-chain fatty acid levels in farmed Atlantic salmon, 2006-2015. Sci. Rep. 6, 21892; doi: 10.1038/srep21892 (2016).

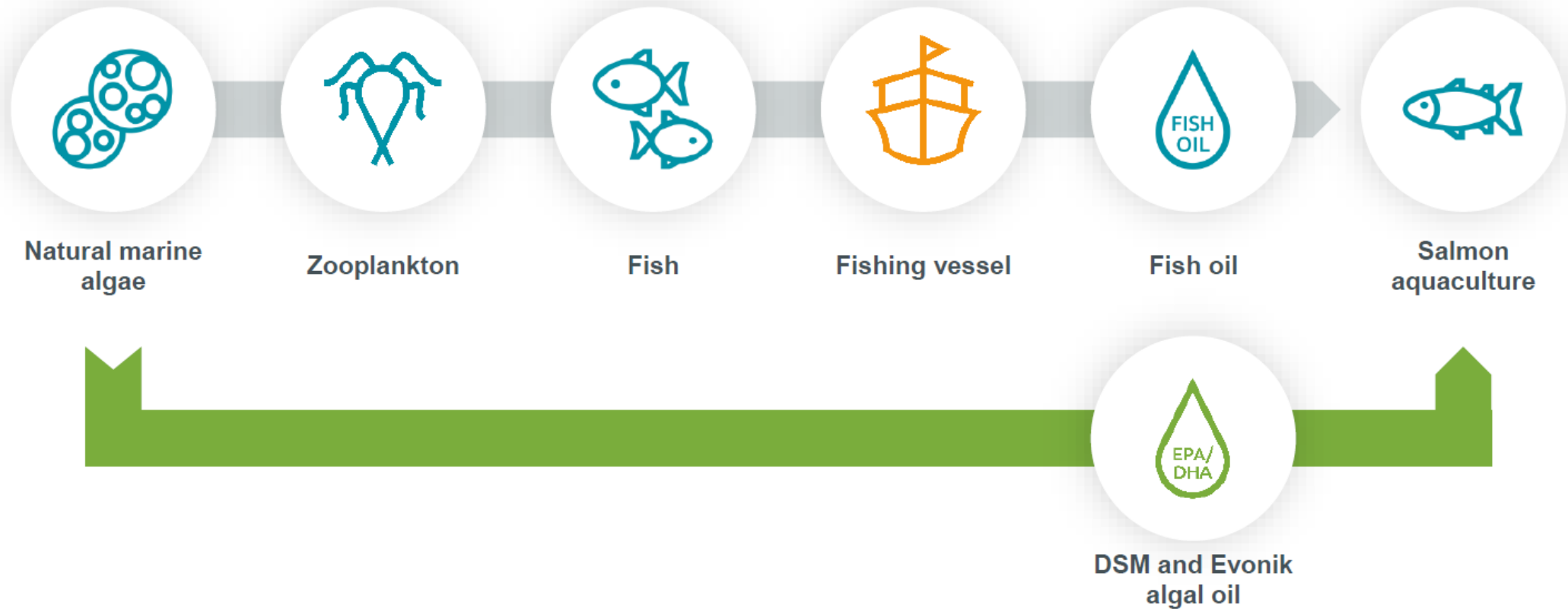


If nothing was done the level of the beneficial omega-3 can only really go down.

Prof Douglas Tocher
Stirling University



OUR NATURAL MARINE ALGAL OIL IS A SUSTAINABLE ALTERNATIVE SOLUTION FOR EPA AND DHA SUPPLY



Veramaris breakthrough - shortening the natural food chain

VERAMARIS ALGAL OIL WILL ENABLE THE FISHFEED INDUSTRY TO KEEP UP WITH THE INCREASING DEMAND FOR EPA AND DHA

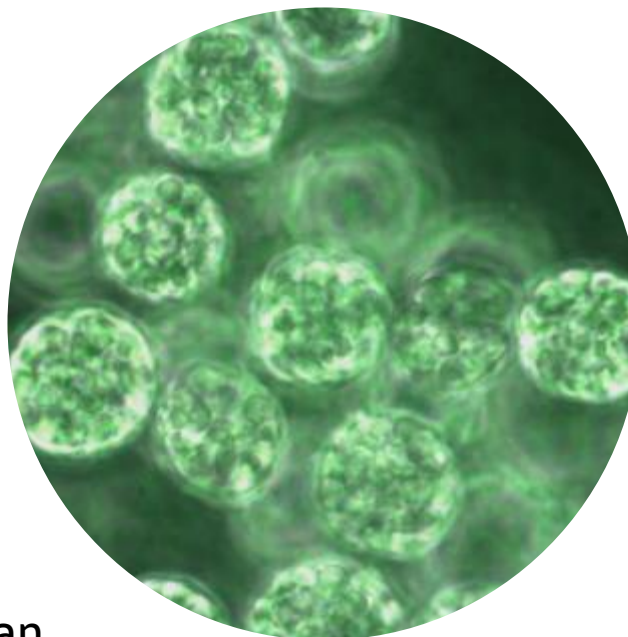
Omega-3 innovation from
natural marine algae

Rich in both
**EPA and DHA for
complete
nutrition**

EPA and DHA content greater than
50%

Image: marine micro algae with omega-3 fatty acid droplets

NO Ethoxyquin



Free from

Ocean-born contaminants such
as dioxins & PCB's

Non-GMO

Broad use in animal nutrition
**from aquaculture
to pet food**

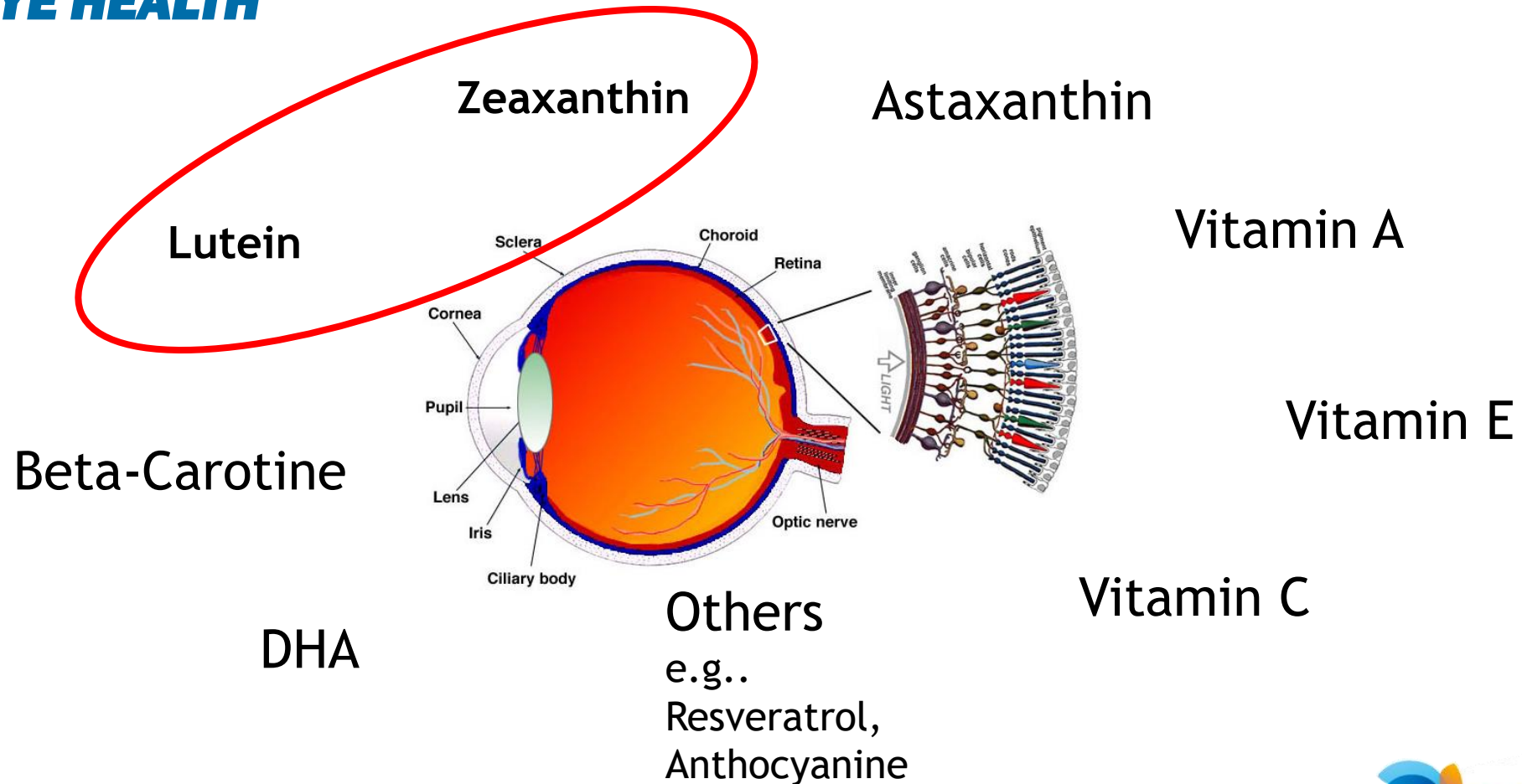
High **purity**

Liquid product

THE MACUWELL™ PROJECT

THE EYE IS A COMPLEX ORGAN.

THE PRESENCE OF SOME SPECIFIC MICRONUTRIENTS ARE IMPORTANT FOR GOOD EYE HEALTH



NUTRITION IS THE KEY FOR GOOD EYE HEALTH

A balanced diet that ensures vitamins, polyunsaturated fatty acids, anti-oxidants and minerals in the recommended amounts is essential for the function and long-term health of the eye.

The nutrients support the function and health of the eye:-

- Protect against oxidative damage
- Maintain the function of the optic nerves
- Reduce the risk of night blindness

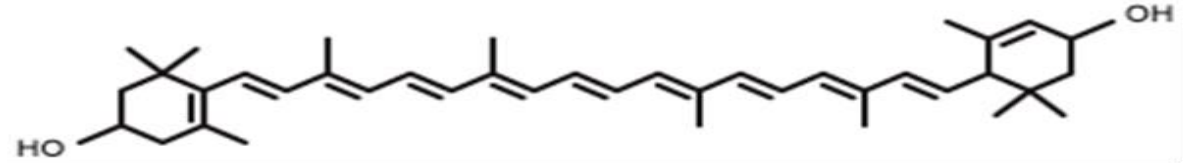
These nutrients can only reach the eye through the diet, the human body can not produce them.

Fortified foods or dietary supplements are an important additional source to supplement the diet.

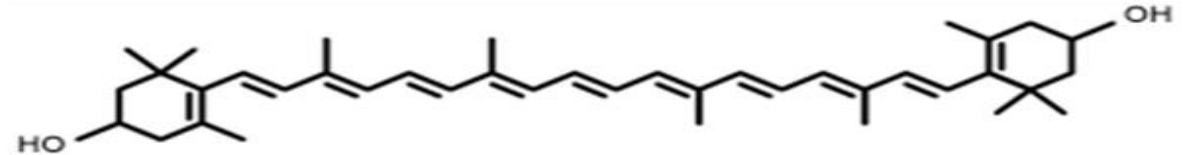
THE MACULA IS RICH IN TWO CAROTINOIDS– LUTEIN UND ZEAXANTHIN.



Lutein



Zeaxanthin

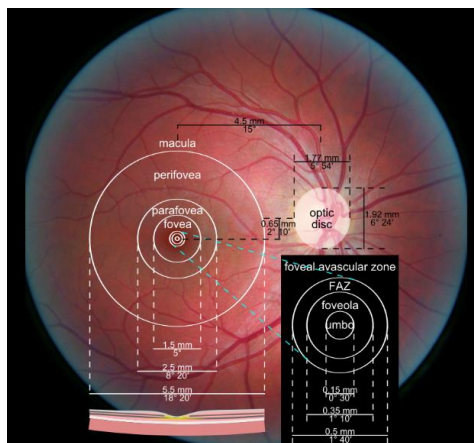
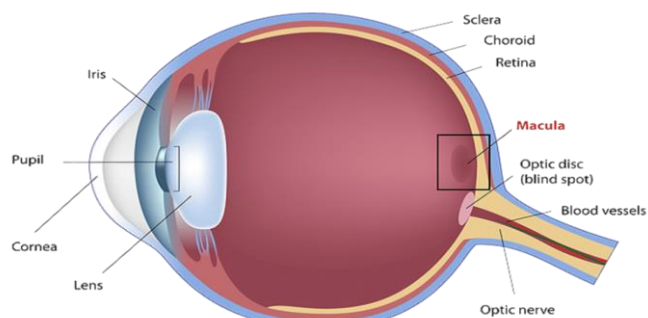


Only two carotenoids from the food chain are found in the macula, about 50 of which we ingest via the diet and of which about 20 are in the blood.

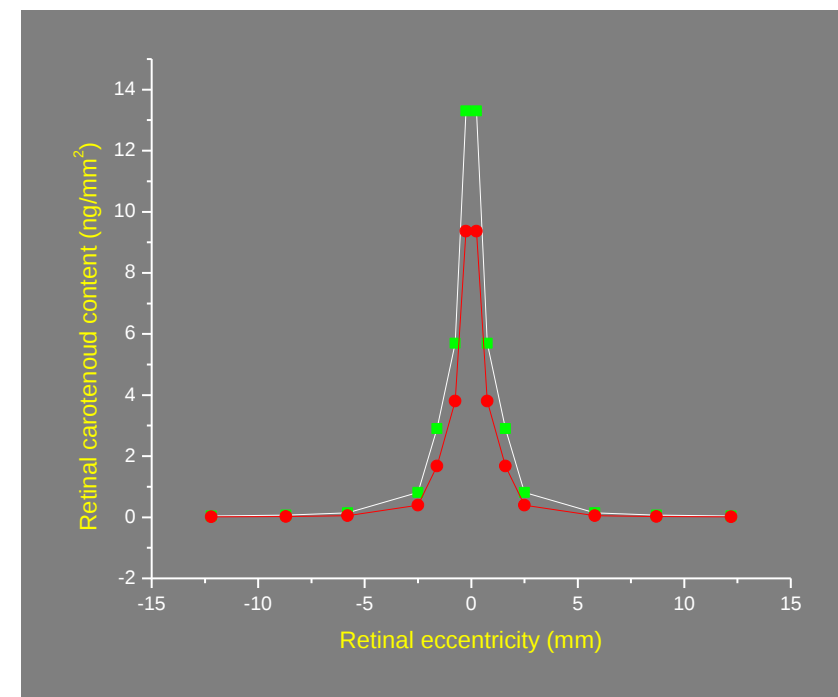
The human body can not produce lutein and zeaxanthin itself Zeaxanthin is an isomer of lutein that has the same primary functions as lutein in the macula, but has a different concentration distribution.

On average, the diet results in a 5: 1 intake of lutein to zeaxanthin For this reason many human studies were done with the same concentration ratio, with lutein being 10 mg and zeaxanthin 2 mg per day

CONCENTRATION OF LUTEIN AND ZEAXANTHIN IN THE MACULA

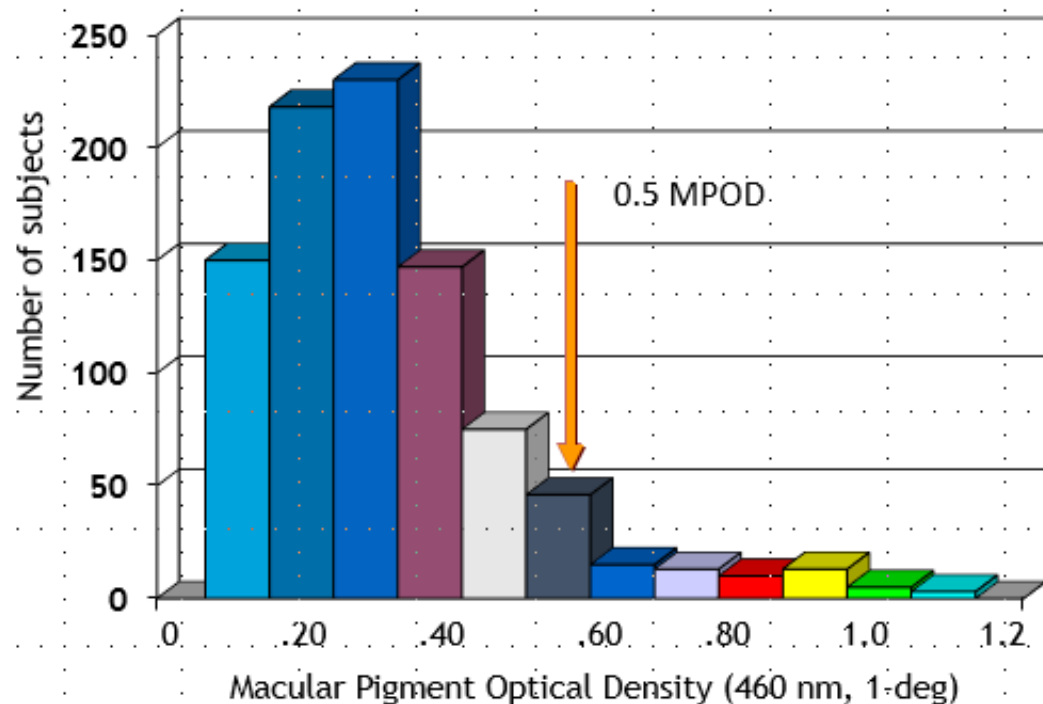


THE RETINAL CAROTENOID CONTENT IS LOW.
THE HIGHEST CONCENTRATION IS IN THE MACULA.
THE ZEAXANTHIN CONCENTRATES IN THE CENTRE.
LUTEIN IS MORE WIDELY DISTRIBUTED



Data provided By Dr. Richard Bone

MANY PEOPLE HAVE LOW MACULA PIGMENT OPTICAL DENSITY (MPOD)

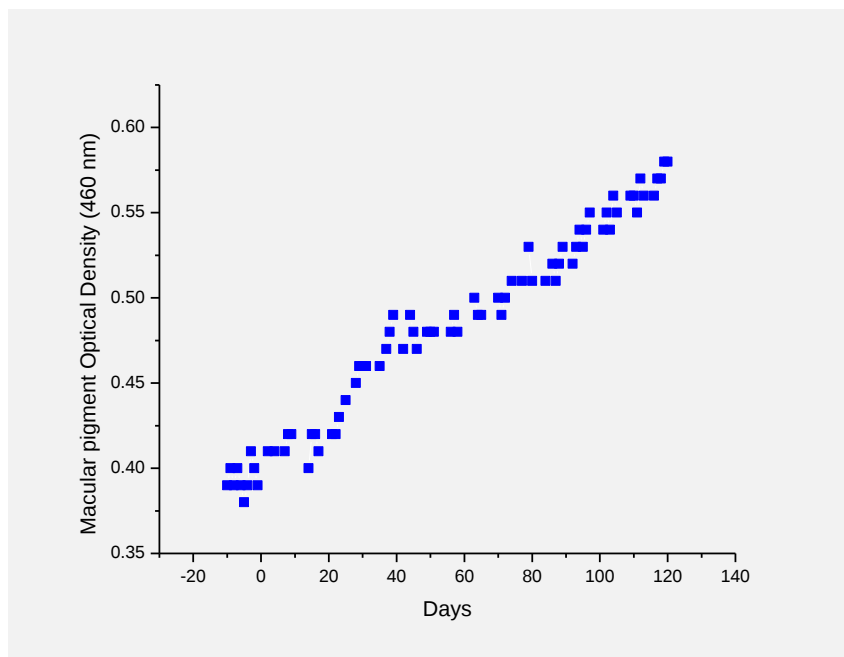


Against the recommended daily intake of 10mg + 2mg Lutein the average levels in Europe for both are actually 0.5-4 mg/day. (*Kemin Discovery' Report* , 2016)

An intake of both of 6 mg per day is required to reduce the risk of age related macular degeneration - the leading cause of sight loss in mature adults. (Seddon et. al. JAMA 1994;272:14120)

Source: Hammond et al. 2002 Invest Ophthalmol Vis Sci 43:47

SUPPLEMENTATION WITH LUTEIN AND ZEAXANTHIN CAN RAPIDLY INCREASE MPOD



Starting at an MPOD <0.4

10mg lutein & 2mg zeaxanthin
supplementation increases
MPOD.

The values increase with the
duration of supplementation.

Adapted from Stringham & Hammond 2008 Optom Vis Sci 85:82

INCIDENCE AND COST OF AMD IN THE EUROPEAN UNION

In 2016, AMD cases among people over the age of 50 in the EU were estimated at 17.1 million.

Of these, 2.53 million, or 18.9% of all AMD cases are severe cases or cases in the last stage.

The total cost of these severe cases and cases in the final stage is € 102.64 billion a year. These costs include direct health costs as well as indirect costs



THE MACUWELL™ PROJECT IN GERMANY

(WWW.MACUWELL.DE)



This project involves both optometrists and industry where equipment is supplied to measure the macular pigment optical density (MPOD) of patients.

MPOD is measured by the optometrist using the MPS II retinal scanner (manufactured by Cambridge based Elektron Eye Technology) that uses heterochromatic flicker photometry (HFP) technology.

If a patient's retina has lower level of pigment density, then more blue light gets through to the retina. As a result, they are particularly susceptible to blue light damaging the light-sensitive cells.

Low MPOD levels reduce visual acuity, and in the long term, leads to the increased risk of sight loss due to age-related macular degeneration.

However, a simple, targeted intervention of a supplement containing the relevant carotenoid pigments: lutein and zeaxanthin, can be directly supplied to the patient by the optometrist and the resulting increase in MPOD measured until it is at an acceptable level.



HOW PERSONALISED NUTRITION IS BECOMING A REALITY IN THE MARKET PLACE

Recent advances in wearable health-related technologies, non-invasive medical biomarker measurement and genotype determination, mean that the holistic benefits offered by micronutrient interventions can now be properly determined.

MIXFIT



Bringing personalized nutrition to you.

There are three main components of the Mixfit system:

1 Mixfit Device

The first at-home nutrient delivery appliance that uses predictive modeling to dispense a great-tasting personalized drink formulated to deliver nutrients your body may be lacking.

2 Mixfit App

The technology platform powered by MINA (Mixfit Intelligent Nutrition Assistant). It integrates key data points from your lifestyle, diet and activity into our proprietary algorithm to formulate your supplement drink in real time.

3 Nutritional Subscription

Never worry about running out — Mixfit offers a simple monthly subscription customized to you. Here's how: the Mixfit device monitors your levels and triggers a shipment to make worrying about refills a thing of the past.

I WANT IT!



Source: www.gomixfit.com

Source: www.nutritioninsight.com

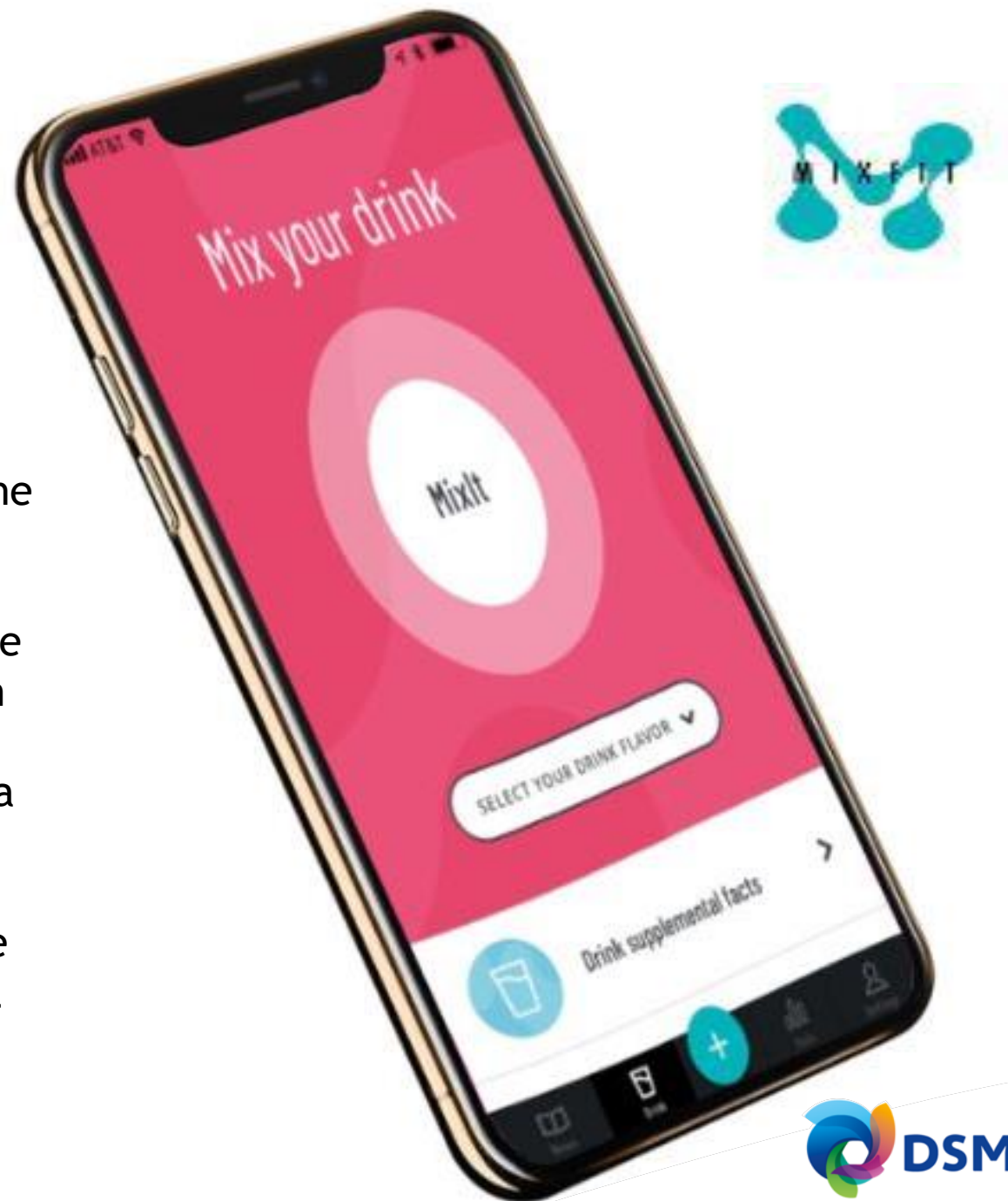
MIXFIT

Mixfit claims to be the first nutrients delivery appliance that uses an algorithm (Mixfit Intelligent Nutrition Assistant or MINA) on a smart phone App (Android and Apple) to determine your nutritional requirements.

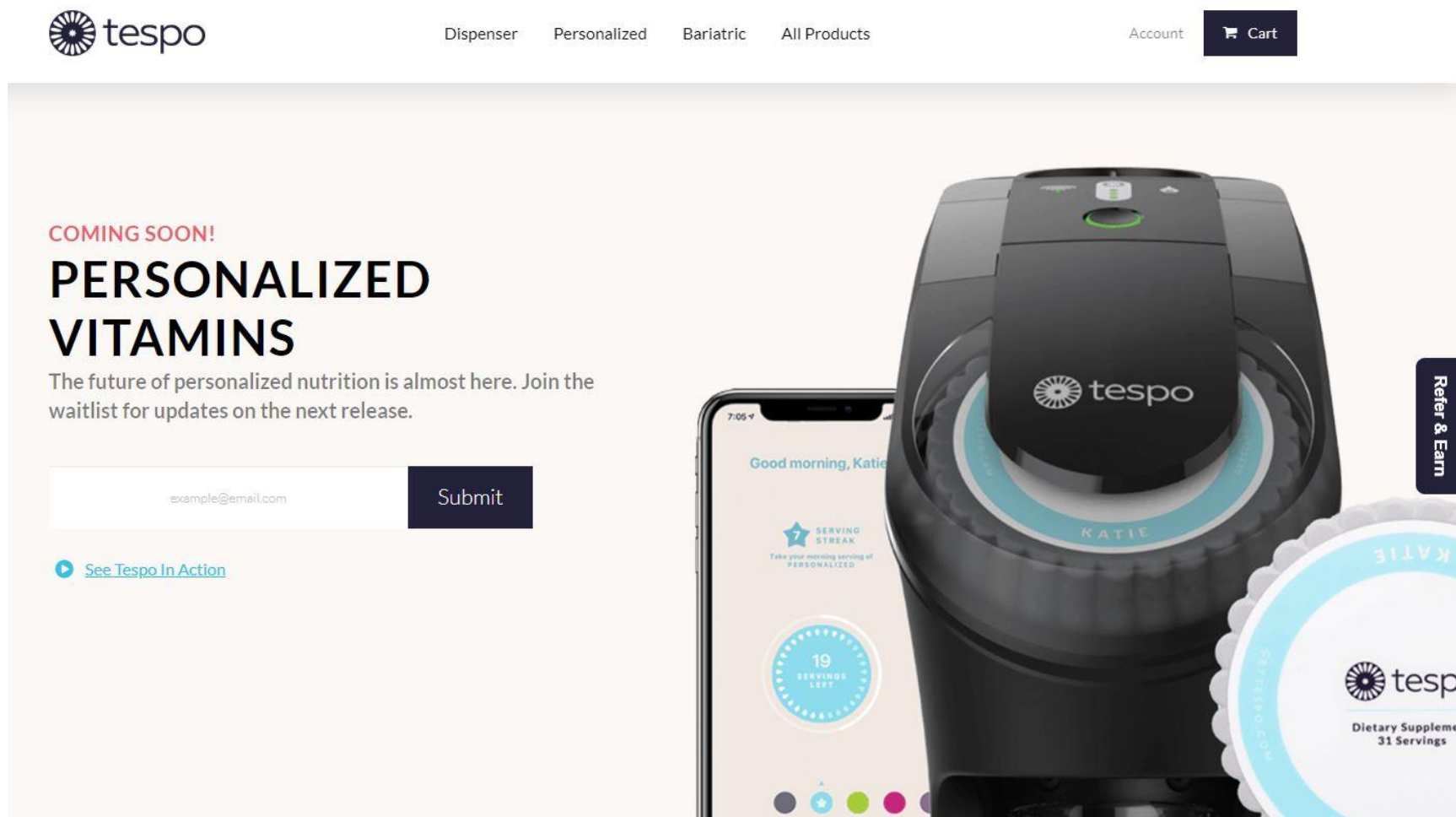
The resultant requirements are then programmed into the Appliance device to produce a ready-to-consume drink.

The Mixfit Device is preloaded with all the necessary core nutrients (23 essential micronutrients) in 8 cannisters. In addition, single use speciality pods can be purchased to achieve a particular nutritional goal e.g. recovery after a workout or provide more energy.

The device is designed to be used twice a day but can be programmed for alternative frequencies. The device will recognise the profiles of each individual in a household.



TESPO VITAMIN DISPENSER



BIOZOOM®



<https://mybiozoom.com/en/products/>

Personalized Formulations Produced in Innovative Forms

Replace Multiple Pills



- with -

Flavorful Gel and Puree Combinations
of Same Actives



Patented Software and Hardware Technology Makes it Possible

Source: www.panaceutics.com

PANACEUTICS



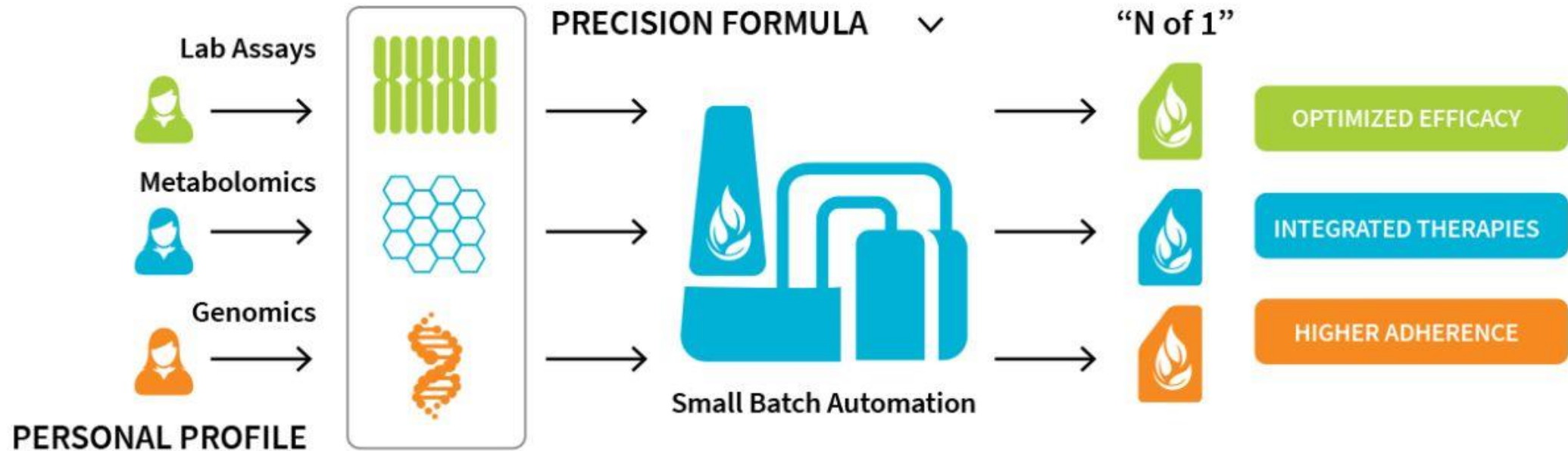
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Source: www.panaceutics.com

SOME FINAL THOUGHTS.....

- Whilst government-led nutrition policies throughout Europe have meant that diseases directly related to extreme micronutrient deficiency are largely a thing of the past, it is increasingly being recognised that the optimum intake of many micronutrients is not being achieved, increasing the risk and early onset of many non-communicable diseases (NCDs).
- The “one size fits all approach” of nutrient intake survey has major limitations. An individual’s micronutrient needs will depend on their genotype.
- Hence, it is important to be able to have “easy to perform” analysis of specific nutrients in blood and other tissues to determine the “in-vivo” status. This provides a strong argument for the concept of personalised nutrition.

Thank you!

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