

NUTRIATHLETIC & BLOOM

Working together towards sustainable food packaging

A blueprint to decrease Swiss SME plastic dependency



PakeG: Tim Bättig, Giammarco Bozzelli, Zayna Chanel, Balthazar Duc, Jeanne Salamin, Shiqi Yang

Plastics pose a **multifaceted environmental challenge**. They produce significant **CO₂ emissions** during production and leave **non-biodegradable waste** that **pollutes** ecosystems.

According to Ocean Care (2023), in Switzerland

- The average consumption of plastic per capita is **127 kg** per year - one of the highest levels world wide
- 85-90% of plastics are **incinerated** and consequentially not recycled or reused

According to Magdalena Klotz (2022), mitigation efforts aim at increasing recycling capabilities and the consequentially required optimisation of plastic separation and collection. The waste problem will however persist if society fails to additionally find substitutes to virgin materials, i.e. **recycled** or **degradable** alternatives.



Reducing plastic consumption is necessary to adhere to the UN Sustainable Development Goals.

Since the plastic problem is too large to be solved by a single player with a single solution, a joint effort of many actors in different sectors becomes increasingly necessary.

Accordingly, this report revolves around a tailored solution for the food packaging industry in Switzerland.

Sources:

- https://www.oceancare.org/en/stories_and_news/europe-switzerland-plastic/
- <https://ethz.ch/en/news-and-events/eth-news/news/2022/02/plastic-recycling-shouldnt-be-an-end-in-itself.html>
- <https://sdgs.un.org/goals>

The current state of materials, machinery and regulation **keep large-scale food manufacturers** from employing more **sustainable plastic alternatives** in their production

There are no incentives for the large-scale food producers to move away from using conventional plastics because

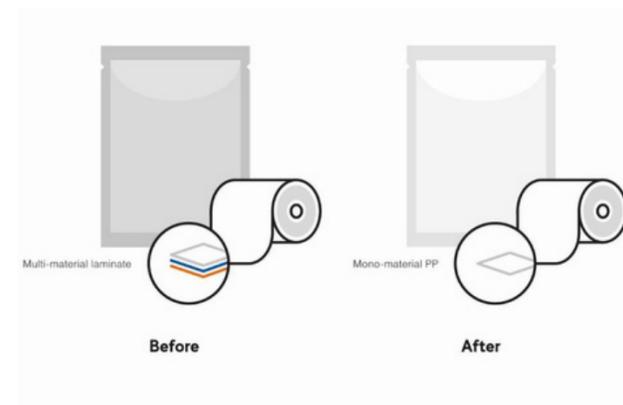
- Existing machines are not adaptable to handle bioplastics
- Replacing machinery is related to high financial investments
- Pressure from governmental institutions and end-consumers is minimal

PakeG, therefore, suggests three **intermediate solutions** for large-scale producers:

1. By reducing the thickness of plastic from 90 μm to 50 μm , which reduces material utilisation by almost half

PA	4 μ
PA	4 μ
HV	8 μ
PA	8 μ
PA	5 μ
EVOH	5 μ
PA	5 μ
HV	7 μ
PE	21 μ
PE	13 μ
PE-Seal	10 μ
Gesamt:	90 μ

2. By using mono-material plastics (PE- or PP-based), which enables more straightforward recycling processes



3. By using paper-based materials (paper + coating), which makes the packaging material compostable



Sources:

- *Ordonnance sur les matériaux et les objets, LPE, LDAI, PPWR, European Commission*
- *Interview with Enrico Visconti (Head of Product Management) and Marco Nese (Global Manager Industry Segment Food Primary Packaging, General Food Conveyors and Applications)*

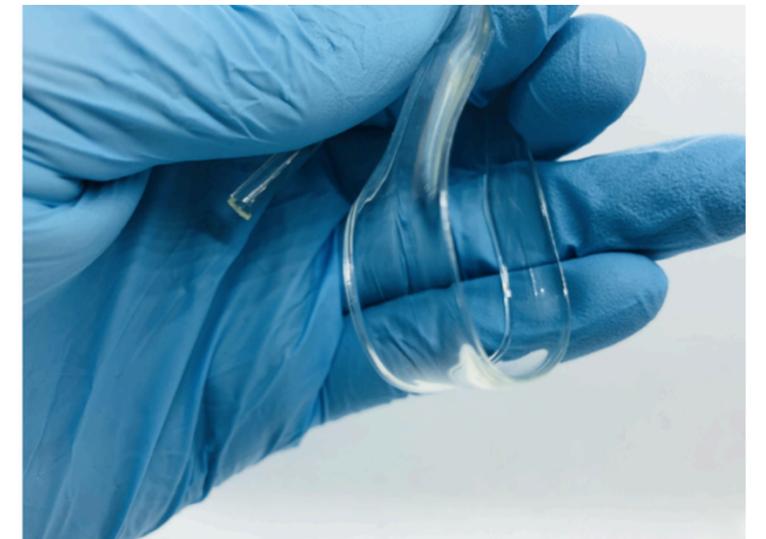
Smaller players are more agile in coping with innovation and disruption. **PakeG** proposes a **blueprint solution** to **substitute existing plastic packaging** with **bioplastic alternatives**.

Initial Question

How can we make Swiss food producers substitute plastic packaging with bioplastic alternatives given the advantageous features of common plastic?

What differentiates bioplastics from common plastics?

- **Sustainable Sourcing:** Bioplastics are derived from biomass, resulting in comparatively lower greenhouse gas emissions during production
- **Biodegradability:** Bioplastics disintegrate in natural environments
- **Property Similarity:** Bioplastics have similar characteristics as conventional plastics. They are lightweight, transparent, and protective against external influences



Sources:

- <https://actu.epfl.ch/news/bloom-biorenewables-develops-biomass-based-plastic/>
- <https://www.bloombiorenewables.com>

Nutriathletic serves as a **proxy for Swiss SMEs** that want to use sustainable packaging options but lack the resources to **properly explore and implement feasible alternatives.**



Who is **NUTRIATHLETIC**®

Nutriathletic is a Swiss SME with around 2 MCHF in annual revenues. It produces and sells sports nutrition such as performance enhancing gels, protein powders, and health supplements.

Why do we focus on Nutriathletic?

Nutriathletic is a typical SME that cares for sustainability. It uses recycled and recyclable packaging for the majority of its products. Protein powders, however, are still packaged in PE cans which are difficult to recycle in Switzerland.



Why Protein Powder?

Its advantageous properties make protein powder durable and easy to handle. Additionally, it is a popular dietary product with a large market whose features are compatible with contemporary requirements of bioplastic packaging.



Sources:

- Interview with Piero Fontana, Founder of Nutriathletic
- <https://nutriathletic.com/faq/#nachhaltigkeit-und-recycling>

Bloom Biorenewables serves as a **proxy for Swiss innovative companies offering** sustainable, degradable **bioplastics alternatives** to standard plastic packaging.

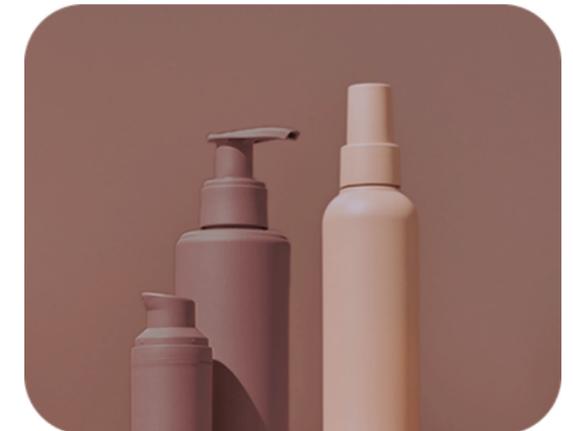
Desirable:

- Offers an alternative to petroleum
- Promotes a circular economy
 - “By using this simple technique, we can convert up to 25% of the weight of agricultural waste, or 95% of purified sugar, into plastic.” *Lorenz Manker*



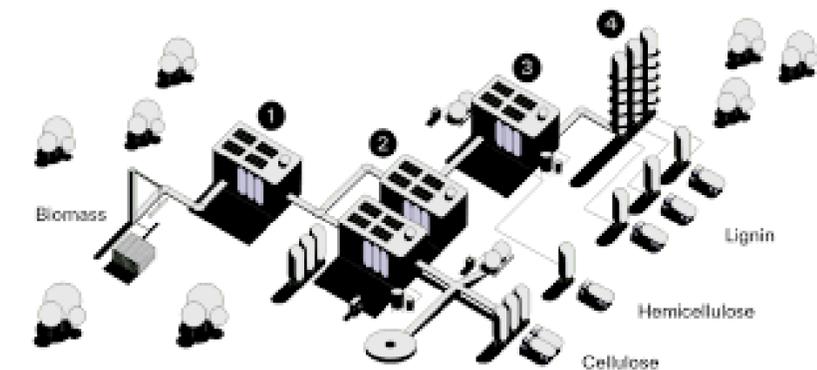
Feasible:

- The use of bioplastic is feasible thanks to its attractive properties
 - “The plastic has very exciting properties, notably for applications like food packaging”. *Jeremy Luterbacher*
- Technology passed proof-of-concept
 - “As PAX are a completely new polyester, all its potential applications have not been fully exploited, but food packing is definitely one of the targeted markets.” *Dr. Ydna Questell-Santiago*



Viable:

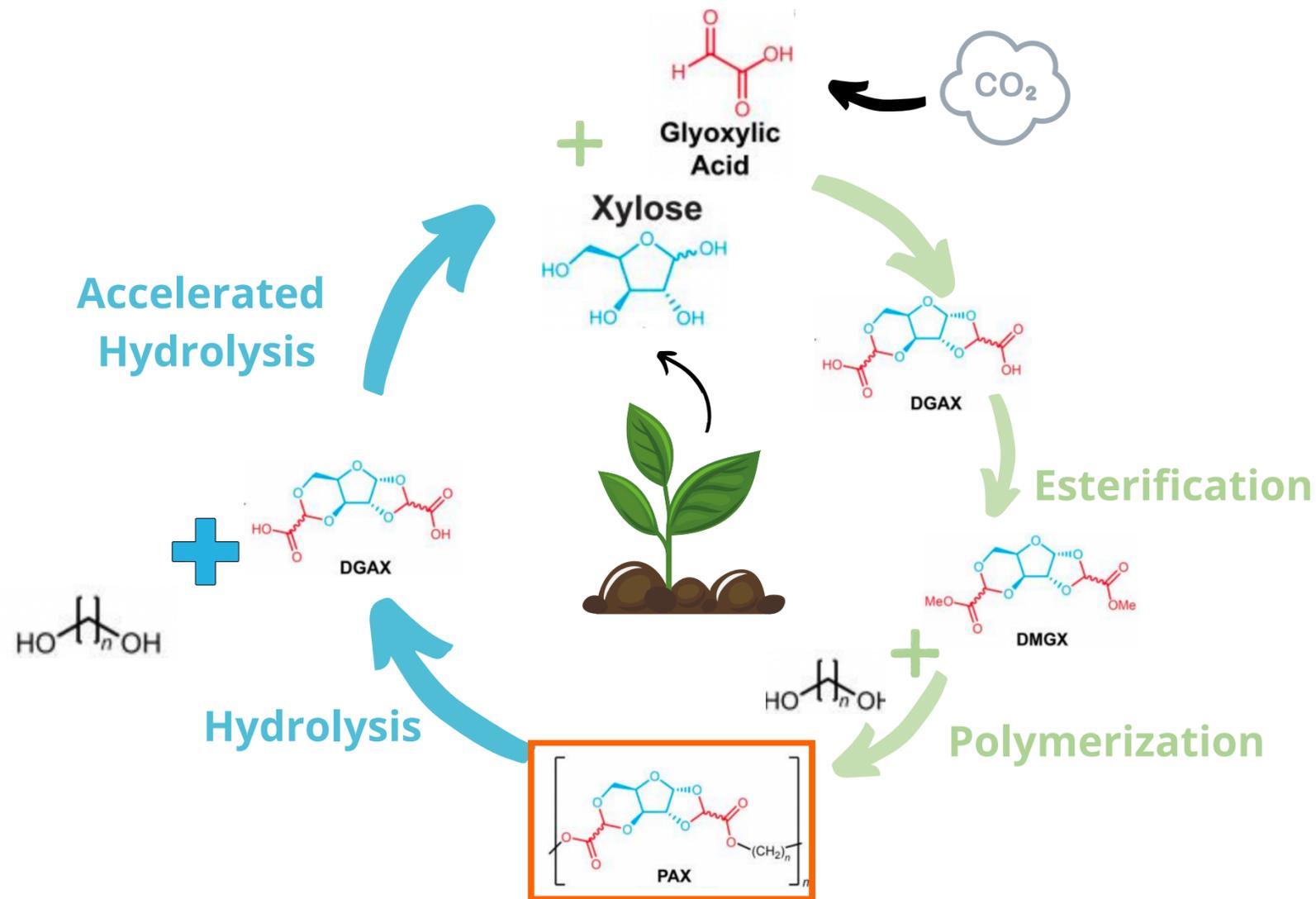
- Scaling up the technology to produce 100'000t/y of Bioplastics by 2026
- Cost-competitiveness, high quality, and sustainable sourcing
 - “Once at tonnage scale, we aim to have a cost-competitive position compared to other biobased plastics such as PLA.” *Dr. Ydna Questell-Santiago*



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- Interview with Dr. Ydna Questell-Santiago

Bloom Biorenewables' **sustainable plastic** is **extracted from plants**, and is **fully recyclable**, representing a **perfect substitute** for standard plastic used in **protein powder packaging**.



PAX's physical properties:

- High glass transition temperature (T_g)
- Good mechanical properties
- Strong gas barrier properties
- Straightforward processability

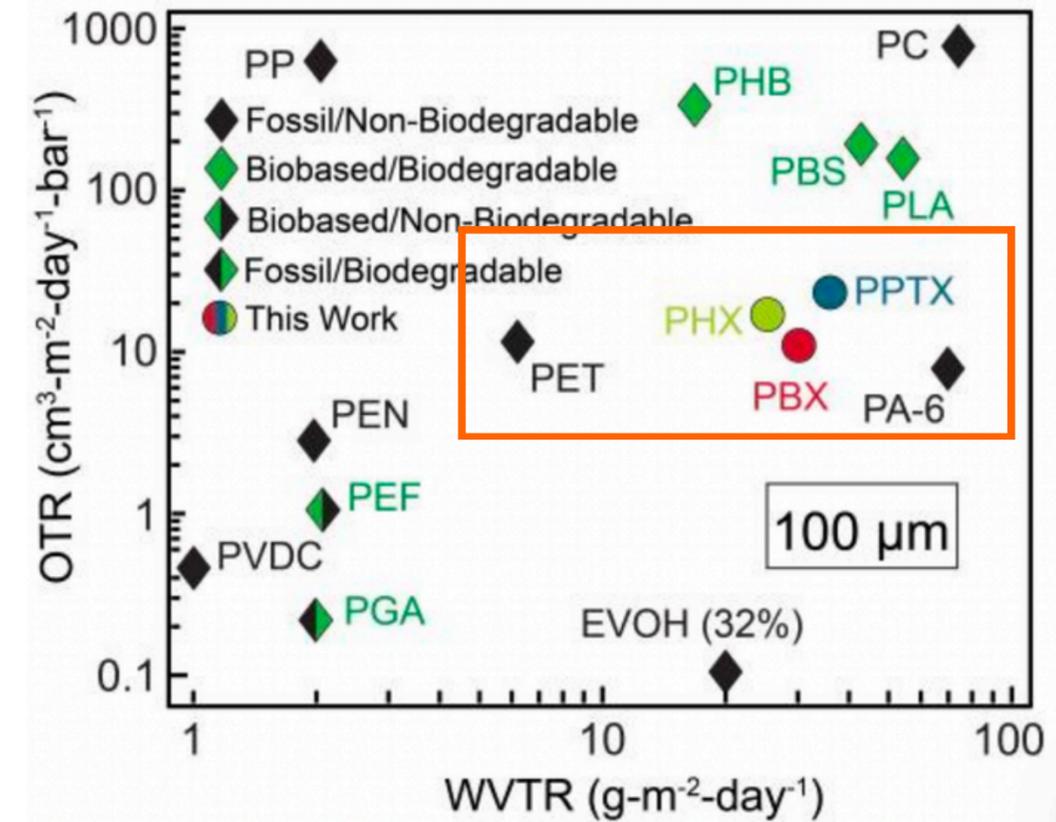


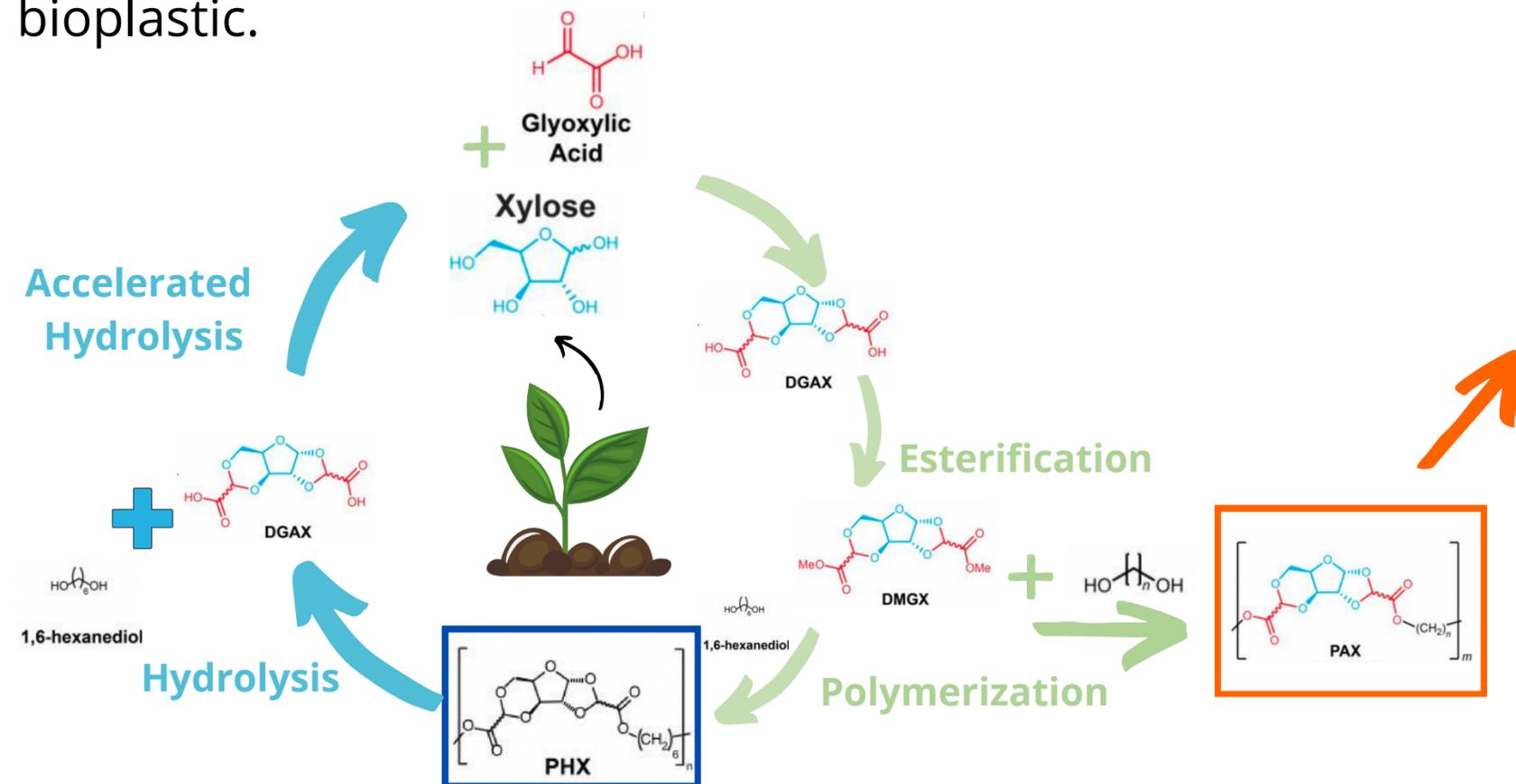
Figure: WVTR (37.8 °C, 90% relative humidity, 100 μm) vs. OTR (23 °C, 50% relative humidity, 1 bar, 100 μm) for PAX and other commercial plastics.

The measured oxygen transmission rates (OTR) of PHX, PPTX, and PBX films were similar to those of PET, with slightly higher water vapor transmission rates (WVTR) potentially lending these biofilms to food packaging applications.

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Direct production of DGAX from xylose and glyoxylic acid, esterification to DMGX, and polymerizing DMGX with a range of diols produced a family of polyesters(PAX). By choosing 1,6-hexanediol and DMGX for polymerization, it can produce PHX. PHX is a specific type of PAX, where the alkylene group is hexylene

PHX can be hydrolyzed to DGAX and diol monomers in extended hydrolytic studies, either slowly at room temperature or faster at 37°C. DGAX can be further broken down into xylose and glyoxylic acid through accelerated hydrolysis in hot water at 100°C. This process allows for the creation and recyclability of Bloom's bioplastic.



PAX physical properties (a suitable raw material for bioplastics):

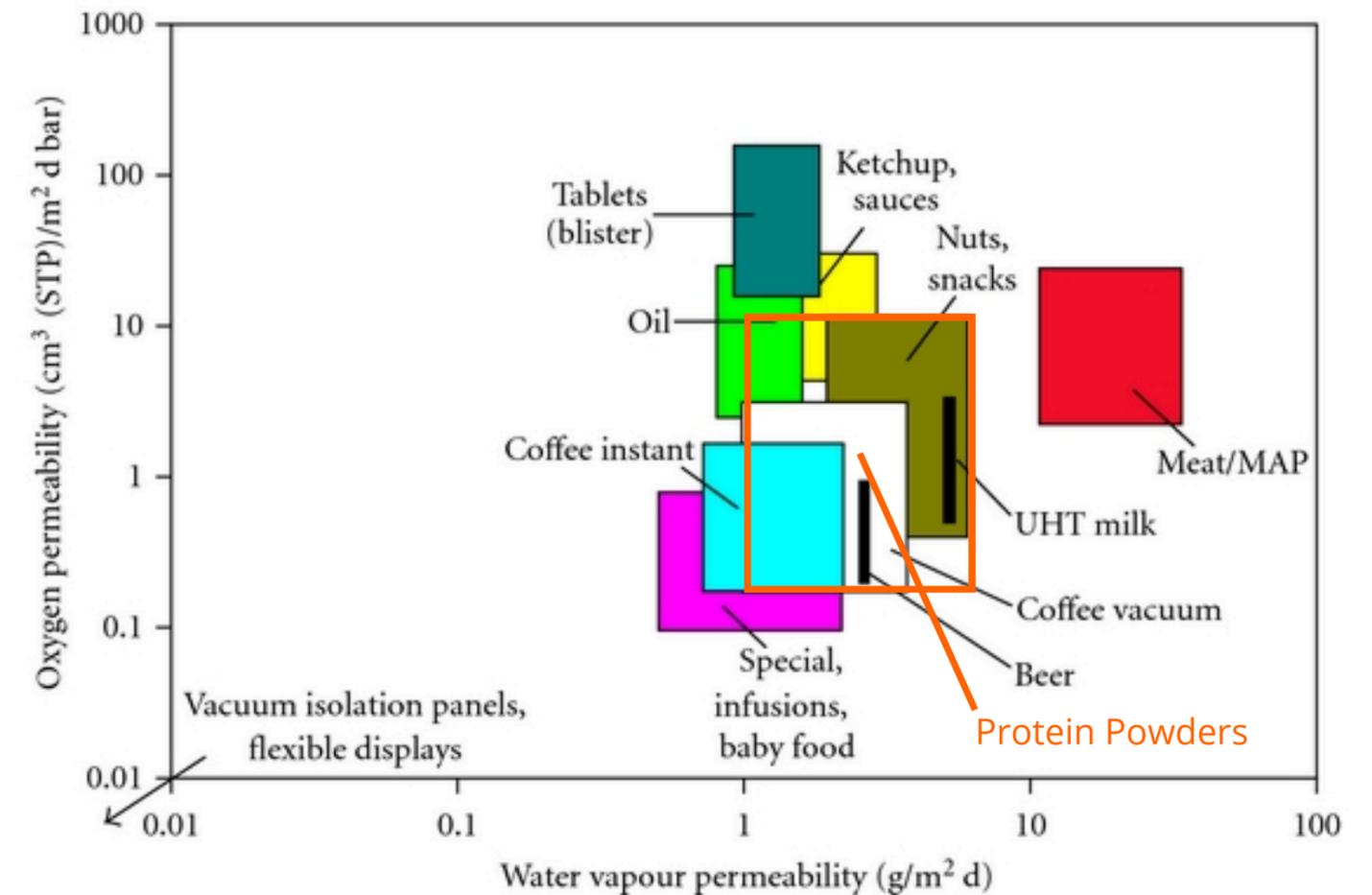
- High glass transition temperature (T_g)
- Good mechanical properties
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Protein powders are **oxygen-resistant** and their production focuses on the number of proteins per gram of products, making them **compatible with bioplastic packaging**.

General material characteristics of protein powders include:

- **Protein Content:** Protein powders are primarily known for their high protein content. The specific protein content can vary depending on the source (e.g., whey, casein, soy, pea, hemp) and processing methods. Protein content is typically expressed as a percentage of total weight.
- **Moisture Content:** Protein powders are usually processed to have low moisture content. This low moisture level helps prevent spoilage and the growth of microorganisms.

Oxygen and water vapour permeability of common foods



Consumers of protein powder are used to relatively high prices and therefore only mildly **price-sensitive**. Passing on higher **bioplastic costs** to the customer will not impact demand.

1,000 US and UK consumers answered a survey designed to reveal how price-sensitive they really are. It was shown that an average **price increase of 17%** is necessary for the respondent to stop buying protein powder.



Cost of 1kg of PET
≈ 1 - 1.5\$

Cost per package
≈ **0,250\$**

One unit of Nutriathletic's protein powder costs **CHF 39**. Assuming a pass-through rate of 100%, we calculate a price increase of ≈ **0,38%** upon switching from common to bioplastic packaging. In line with the above mentioned study, this increase is not expected to affect product demand.



Cost of 1kg of Bioplastic
≈ 1.5 - 2.5\$

Cost per package
≈ **0,4\$**

Sources:

- <https://ingredient-communications.prezly.com/press-release-5vbdwz>
- <https://nutriathletic.com/en/product/grow/>
- Interview with Lorenz Manker Chemical engineer & biochemist at Bloom Biorenewables

Nutriathletic's protein powders' properties make them the **perfect products to be packaged** in plastic material made from non-edible parts of plants, such as those produced **by Bloom.**

BLOOM

- Bioplastic has enough oxygen resistance properties
- Bloom offers biodegradable and sustainable packaging solutions
- There is a willingness to find partners to implement the technology on the market



START NOW!

And become a pioneer in sustainable packaging

NUTRIATHLETIC®

- Protein powder is oxygen resistant
- Nutriathletic relies on plastic and aluminium packaging for its sports food supplements
- There's a desire to move towards more sustainable packaging solutions



Bloom is always open to new collaborations specially when the vision of bringing real, sustainable alternatives to the industrial market is shared.

This project is an exciting initiative. (...) This might open new lines of collaboration for us and other companies working in the same direction.

Dr. Ydna Questell-Santiago: CTO and Regulatory Affairs at Bloom Biorenewables



PakeG divides its overall **takeaways** in **three sections**: Experiencing the FrED framework, the plastic packaging problem and team dynamics.

Experiencing FrED framework and Dragonmaster

- **Interact** with **industry professionals** and gain practical experience through fieldwork
- Embrace **challenging deadlines** to foster innovation
- Apply simple solutions to address complex problems by **pinpointing root causes**
- **Test hypotheses** promptly, remaining **open to modification** based on opposing evidence
- Utilise **iterations** for incremental refinement and improvement of work
- Employ the **hero, treasure, dragon** method to formalise clear and appropriate quests

Plastic Packaging Problem

- Acknowledge the **global issue** of plastic pollution
- Advocate for **joint efforts from all stakeholders** in the supply chain to reduce plastic packaging
- Emphasise the necessity of **integrated solutions**, valuing even small impacts over no impact

Team Dynamics and Collaboration

- Foster team coherence by **splitting work** and **trusting** each team member's skills
- Implement **brainwriting** to minimise groupthink, reduce social pressure, and ensure equal participation
- Recognise the importance of each team member, as **a team is only as strong as its weakest link** (paper clip analogy)
- Value internal and external **feedback as a gift**

We want to express our **sincere gratitude** to all those who generously contributed their invaluable support and expertise in making this project possible.

Enrico Visconti: Head of Product Management at Habasit International AG

Marco Nese: Global Manager Industry Segment Food Primary Packaging, General Food Conveyors and Applications

Lorenz Manker: Chemical engineer & biochemist, Postdoctoral Researcher

Thibault Rambert: Laborantin chez Ecole polytechnique fédérale de Lausanne

Dr. Ydna Questell-Santiago: CTO and Regulatory Affairs at Bloom Biorenewables SA

Roger Härki: CEO at Ethno & Company AG

Christoph Möhl: CEO and Chairman at Mosterei Möhl AG

Dr. Piero Fontana: Founder and CEO of Nutriathletic

BLOOM

NUTRIATHLETIC®

EPFL

IMA SPA

habasit

MÖHL
Das Beste aus dem Apfel

ethno
& Company

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