always
inspiring more ...

VALORIZATION OF SIDE STREAM

IN COSMETIC INGREDIENTS

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PhD student at Symrise / AMU

Supercritical Fluids ; Perfumery, Cosmetics and Flavors - November 25, 2021

Agenda

The Topics

1. What's up in the world ?
2. What is Symrise position ?
3. PhD thesis: How to valorize side stream in cosmetics ?

Key definitions

Upcycling
Definition

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RECYCLING

Converts **waste** into **reusable material** so that it can be **consumed once again.**

Plastic bottles

Chemical transformation

Pen using recycled plastic as raw material

UPCYCLING

Integrates discarded components and materials **no longer needed** into a new range of diverse products within open-loop cycles with **added values**.

Plastic bottles

Used as such for a chair

ADDED VALUE

RE PURPOSED

ENERGY SAVING

Upcycling
Co-product or by-product?

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CO-PRODUCT

Additional material generated during a production **run together with a main valuable** product. Both products are planned and of **equal importance**.

Example:

Coconut

- Flesh — **MAIN PRODUCT**
- Water — **CO PRODUCT**

Of main importance, both are consumed

- Shell — **BY PRODUCT**

Not desirable in the first place
Can be valorized

BY-PRODUCT

Secondary unplanned product derived from a manufacturing process or chemical reaction, it is not the primary product being produced and is most of the time an undesirable product.

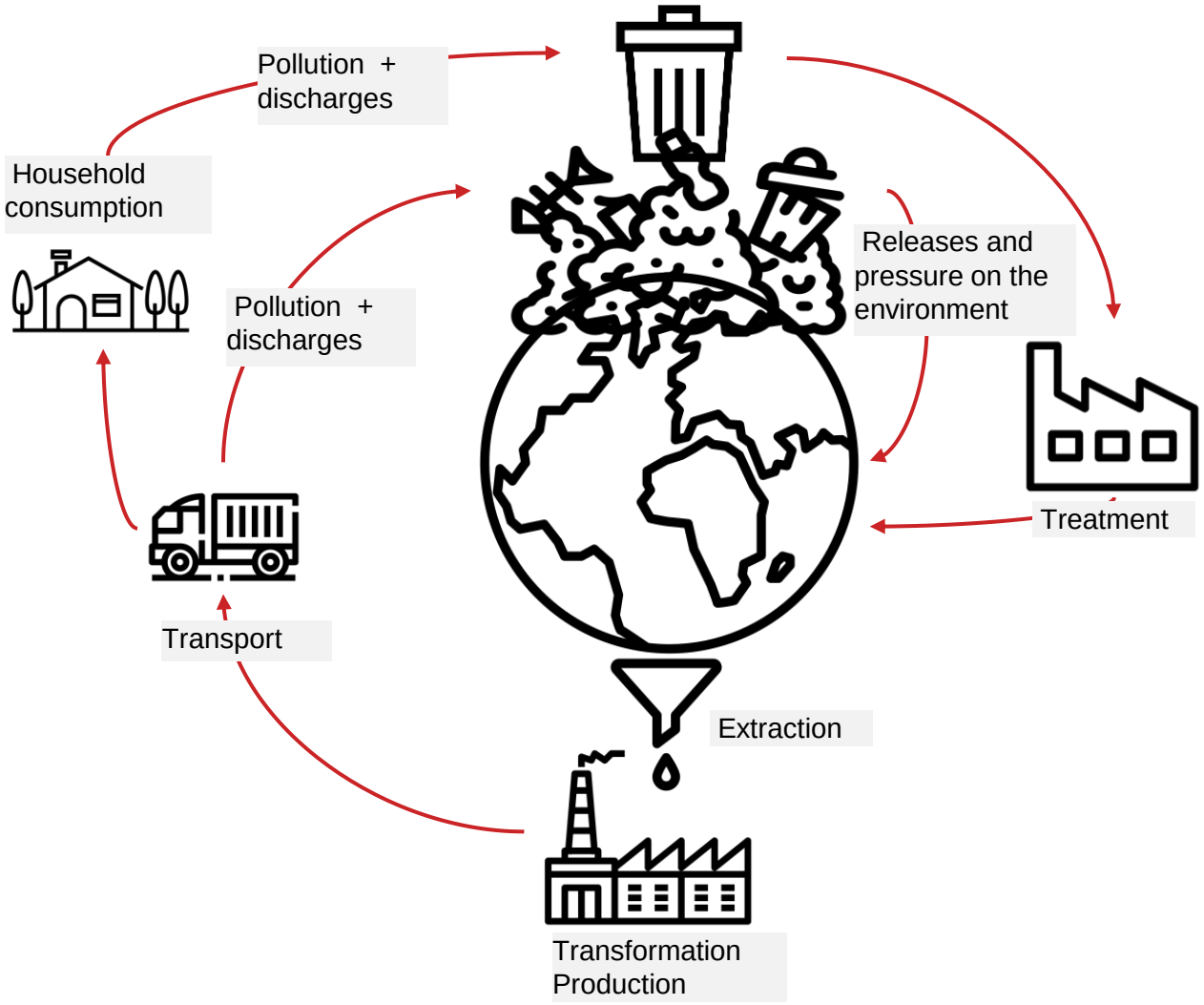
➔ Rich in **valuable compounds**.
➔ Their characterization and valorization could not only convert them into high value products but would also **reduce the waste environmental impact and the related treatment costs.**

Side stream

Environmental concerns

Keys facts

Use of environmental ressources



THREE TYPES OF RESSOURCES

Mineral and fossils ressources
Gas, petroleum, charcoal, minerals

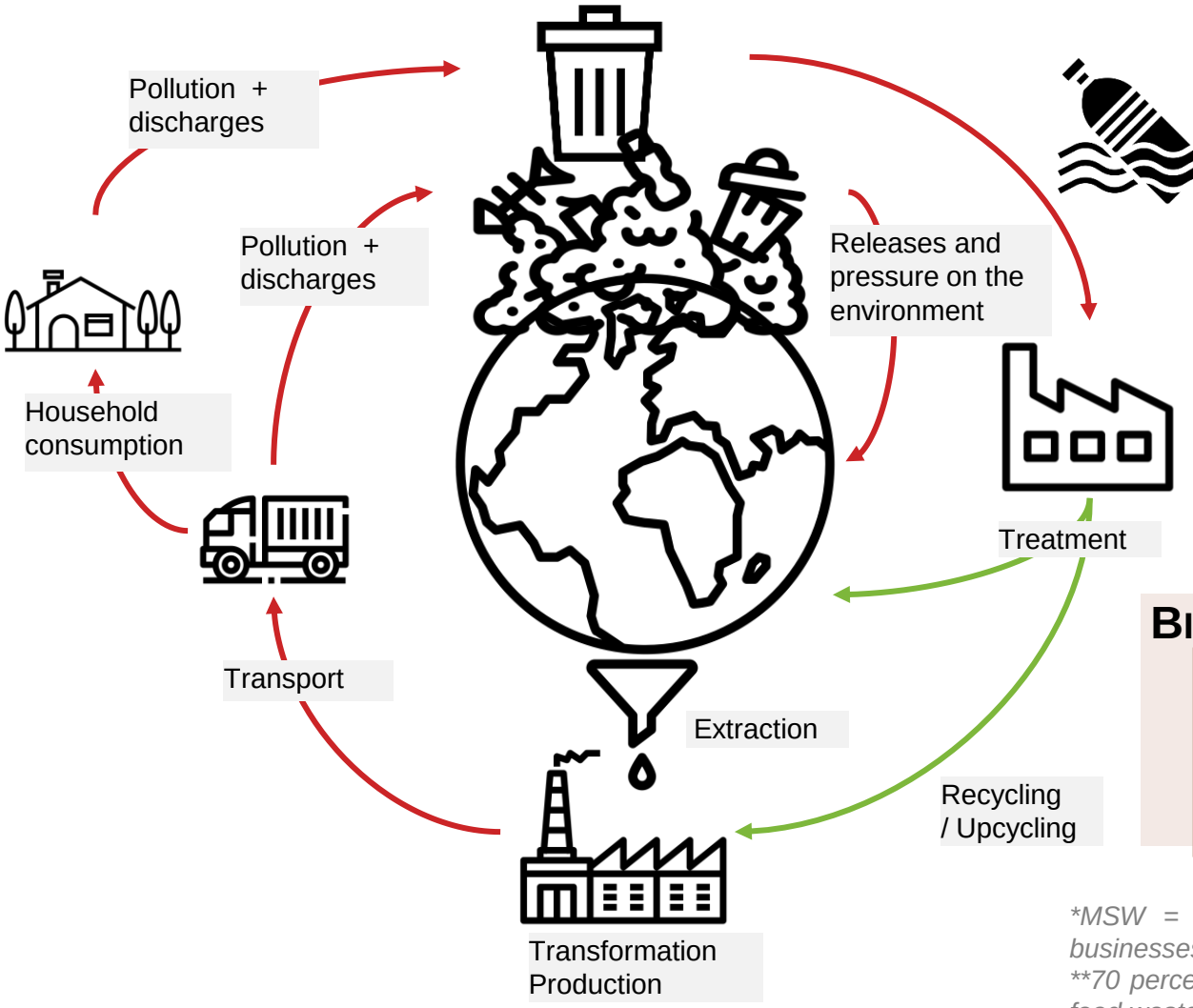
Organic ressources
Agriculture, food, textiles

Inorganic ressources
Waters, air, soils

Source: Modified from http://les.cahiers-developpement-durable.be

Keys facts

Use of environmental ressources



By 2050, there will be **more plastic** in the ocean than fish.

1.3 billion tonnes

of food wasted globally

(Not only including MSW)***

BIODIVERSITY IS PRECIOUS AND HAS TO BE PRESERVED

The world has more than **20,000** edible plants, but **75%** of the global food supply comes from just **12 plants and five animal species.**

Source: Modified from http://les.cahiers-developpement-durable.be

**MSW = Municipal Solid Waste: everyday items coming from homes, schools, hospitals, and businesses.*

***70 percent of waste comes from food service, retail, and households - the remaining 30 percent of food waste occurs in the production and processing spheres.*

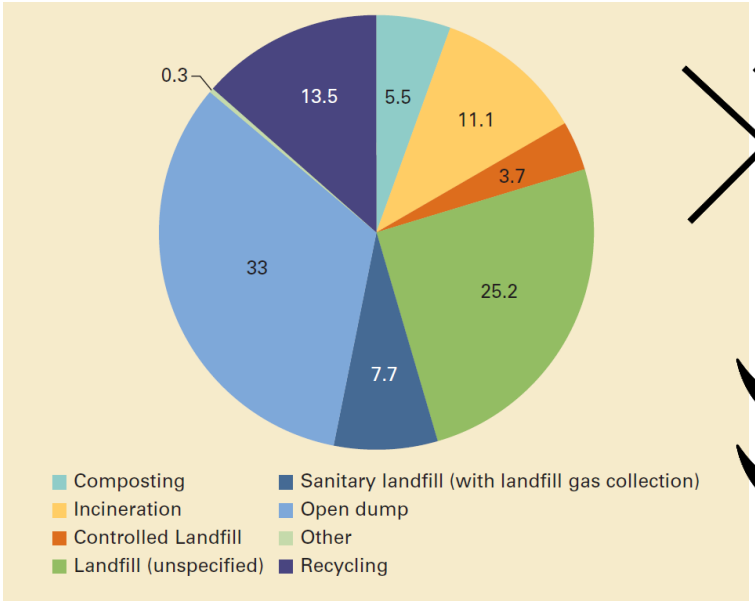
Keys facts

A hidden potential

The world throws away **2.01 billion tonnes** of products* annually.

Expected to grow to **3.40 billion tonnes** by **2050**.

GLOBAL TREATMENT AND DISPOSAL OF WASTE*



Only **13.5%** of global waste* is recycled.

44% of waste* (MSW*) represents **food & green**

WASTE MANAGEMENT
OVERCONSUMPTION

TOP CONCERNS

Source: datatopics.worldbank.org –Data 2018 –most recent available

**Municipal Solid Waste: everyday items coming from homes, schools, hospitals, and businesses.*

To A Clear Beauty
Motivations

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THE PUSH FOR MORE CLARITY

81% **I always check** for the **ingredients** of products I buy

69% of women are seeking out **reliable information** sources to help tell them which ingredients are **good or bad** for them.

- **Conscious** consumers
- Bad press, molecules under scrutiny, **fear of ingredients** (green washing)

➔ **Education**: explain what the product contains and ***not*** what it should not contain.

- Calling for **certifications**: Consumers like to see a logo because it provides **reassurance**.

HEALTH + **SUSTAINABILITY & CONSCIOUSNESS** *(planet+ethic)* + **TRANSPARENCY & TRUST** → Clear BEAUTY

Source: Stylus «decoding clear beauty »

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At a glance

Symrise Group
Highlights 2020

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3.5 billion €
in sales
+ 3.3 %

+2.7%
Organic growth

~ 16,4 %
of sales
is attributed to Investment
in **R&D**

>6,000
Customers
in 160 countries

30,000
Fragrance
Cosmetic Ingredients
products
Flavors
Pet Food

10,665
Employees (including trainees and apprentices)

Symrise Group
Trans-Divisional Optimization

Segment	Flavor	Nutrition	Scent & Care		
Division	*Flavor*	*Diana*	*Fragrance*	*Cosmetic Ingredients*	*Aroma Molecules*
					
Business Unit	Beverages Savory Sweet	Food Pet Food Aqua Probi	Fine Fragrances Beauty Care Home Care Oral Care	Actives & Micro Protection Botanical Extracts & Color Solutions Sun Protection & Functionals	Menthols & Coolants, Terpenes, Special Fragrance & Flavor Ingredients, Gasodor® S-free
Sourcing Interactions	Natural ingredients Extraction technologies	Sustainable food Back to the field Standardized extraction	Madagascar's Vanilla Scent Beauty+ Initiative	African Oils Cranberry 360° Hemp Oil	Pine Terpene based ingredients

Symrise Corporate Ambitions

Sustainable development goals

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Footprint

Minimize environmental footprint along the value chain with particular focus on improving energy efficiency and conserving water resources

Innovation

Innovate across the business to maximize positive social & environmental impacts e.g. by optimizing our palette of ingredients

Sourcing

Maximize the sustainability of our supply chain and raw materials with specific emphasis on traceability and social equality

Care

Improve wellbeing in communities by focusing on work safety, managing social risk and inspiring our people to become sustainability advocates

Corporate Sustainability Goals

2020 / 2025 Targets

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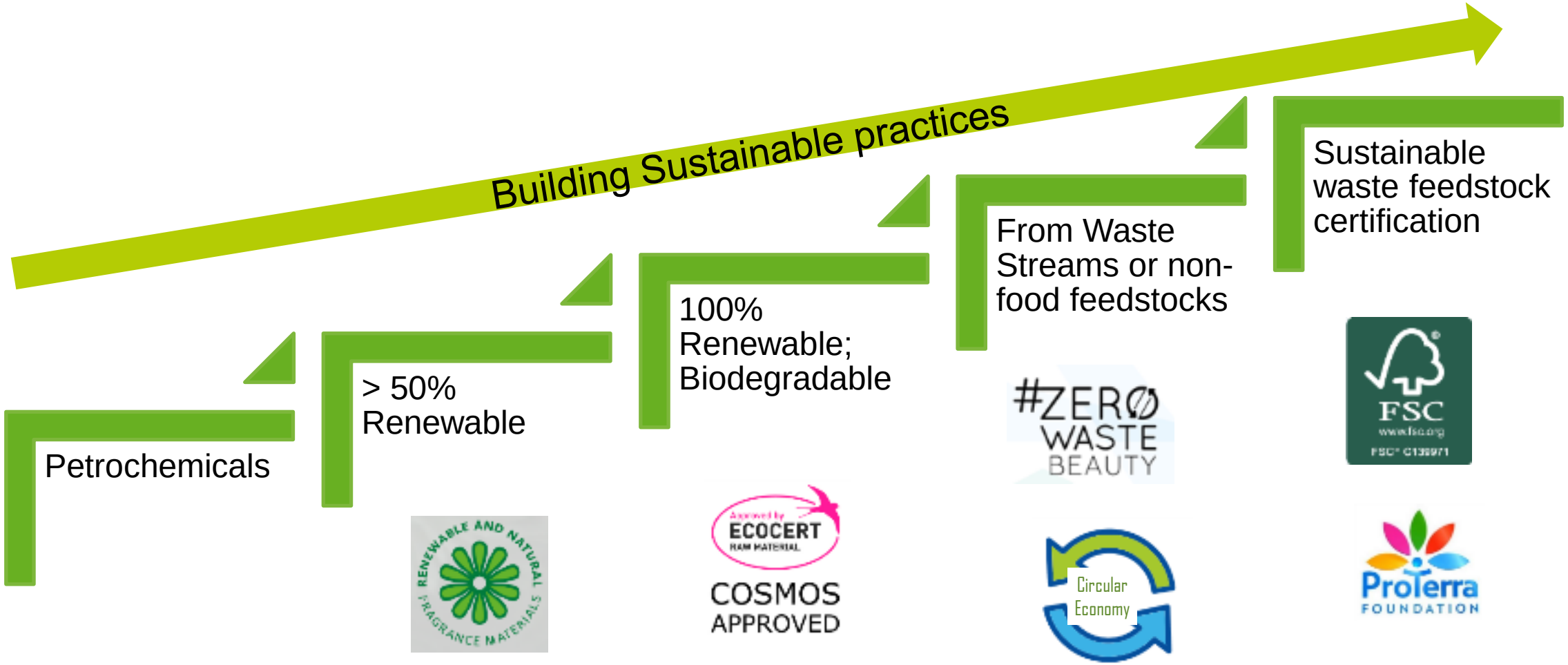
Footprint	**Climate protection** * -5% -5.6% *emissions of greenhouse gases annually*	**Process yield** * -4% -4 % *Chemical demand in waste water annually*	**Resource efficiency** * -4% -4 % *hazardous Waste annually*
Innovation	**Responsible Innovation** *We develop new products that account for a share of sales of more than 10% over the past 3 years and* > **12%** *in 2025.*		
Sourcing	**Sustainable Sourcing** * 100% 100 % *our primary suppliers will be measured by sustainability criteria.*	**Palm oil** * 100% 100 % *Raw materials and derivatives from sustainable sources.*	**Full Traceability** * 100% 100 % *Of our strategic raw materials*
Care	**Diversity and equal participation of women** * 17% 20 % *at first management level*	**Health and Safety** * <2.5% <1.5 *MAQ accident frequency*	

*** 2020 target / *2025 target***

World Without Waste

Green Chemistry and Circular economy



How?

Through Entreprenarial Vision

diana

Cranberry 360°

SUCCESSFUL CROSSDIVISIONAL PARTNERSHIP

- Nutrition segment of Symrise
- Human food, pet food, aquafeed, nutraceutical

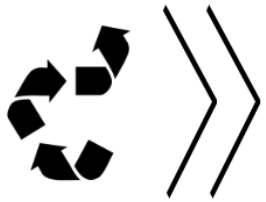
- Premium upcycling botanicals
- Valorisation of natural co-products rich in active molecules

Main products used by the Food and Nutraceutic industries

- Fresh fruits
- Juice
- Extracts

(Diana process for food supplements)

➢ Pomace
➢ Seed



- Residual water ➔ **Actipone® Alpha Cranberry CA**
- Peel ➔ **Neo Actipone® Cranberry CA**
- Seed ➔ **Cranberry Oil CC**
- Press cake ➔ **On going valorization**

Valorization of side stream

Opportunities & Challenges

Valorization of side stream

PhD Thesis

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'Valorization of side stream with the use of green technologies'

2020-2023

M2P2 : Elisabeth Badens & Christelle Crampon
Symrise: Arnaud Bellon

M2P2 UMR 7340 CNRS - Aix Marseille Universités - Ecole Centrale Marseille

Cifre Conventions

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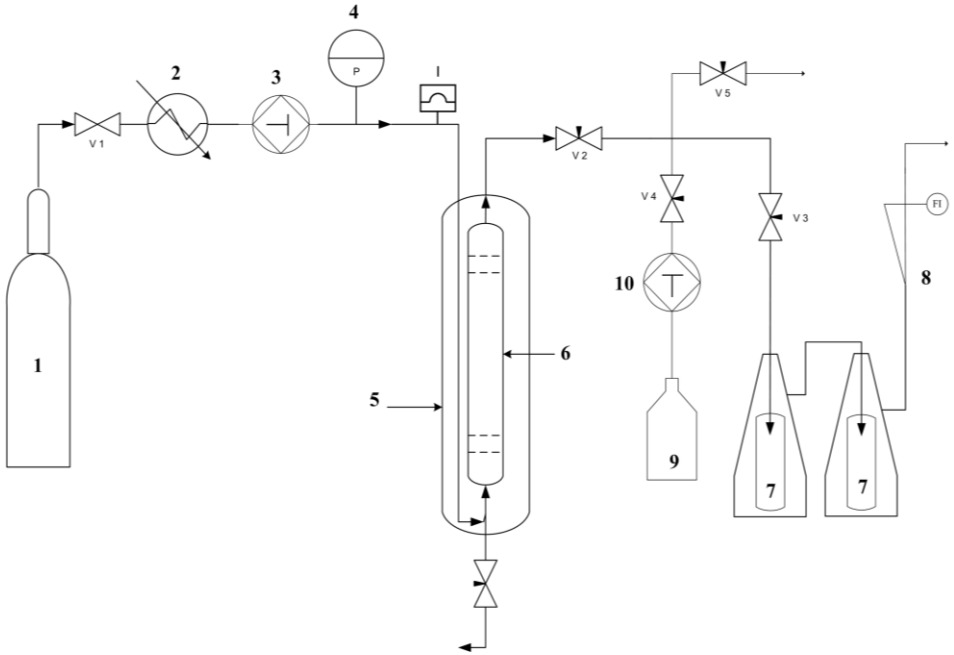
- Study different **green extraction processes** to upcycle Symrise's side stream
- Developing an integrated process of extraction allowing to **selectively separate the compounds**
- **Industrial transposition**

Supercritical fluid extraction

Sc-CO_2 extraction setup



Supercritical CO_2 setup

Advantages of the use of supercritical CO_2 for side stream

- ✓ Intermediate properties between gas and liquids
- ✓ CO_2: variable geometric solvent
- ✓ Supercritical point of CO_2: **T= 31,1°C / P= 73,8 Bar**
- ✓ High Selectivity with the experimentals conditions
- ✓ Possibility to use the moisture content inside the biomass as co-solvent for extraction

Apple pomace

Compounds targeted

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APPLE POMACE

Apple residue:

- 20-35% of residue from the fresh fruit

Compounds targeted:

- Fatty alcohols: 41%
- Fatty acids : 15%
- Waxes: 6 - 10%
- Sugars: 3%
- Triterpenoids: 2%
- Antioxidants : 5 mg TEA* / g of extract

**TEA: Trolox Equivalent Antioxidant*

Cosmetic applications:

- Natural barrier / Protection from water loss
- Antioxidant/ antimicrobial
- Sebum regulation
- Anti-ageing
- Hair protector
- Emulsifying properties
- Soothing

References:

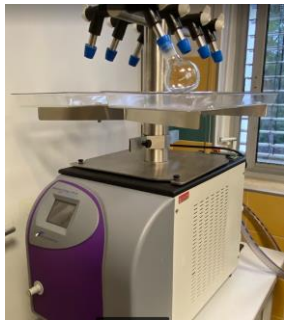
- *Ferrentino et al., Biorecovery of antioxidants from apple pomace by supercritical fluid extraction, 2018*
- *Li et al, Supercritical Carbon Dioxide and Hexane Extraction of Wax from Apple Peel Pomace: Content, Composition, and Thermal Properties, 2015*
- *Rebetafika et al, Fractionnation of apple by-products as source of new ingredients, current situation and perspectives, 2014*
- *Shalini & Gupta, Utilization of pomace from apple processing industries: a review, 2010*

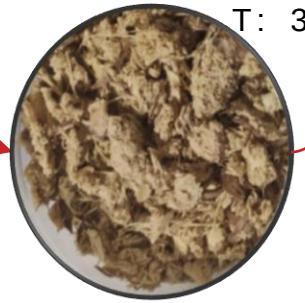
Apple pomace valorization

Step by step

Pretreatments

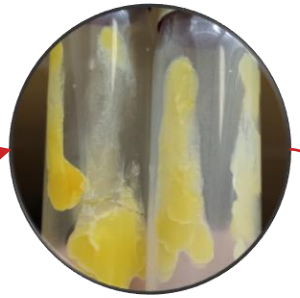
Freeze-drying
Air drying





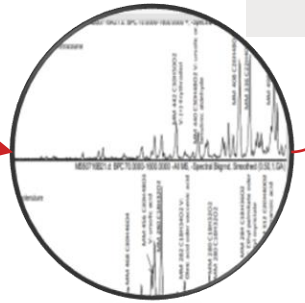
Supercritical CO_2 extraction

P: 100 – 400 Bar
T: 35 – 55°C



Qualitative & Quantitative analysis

LC-MS
GC-MS



Extraction
Modelling
Fractionation
Shaping of the extracts

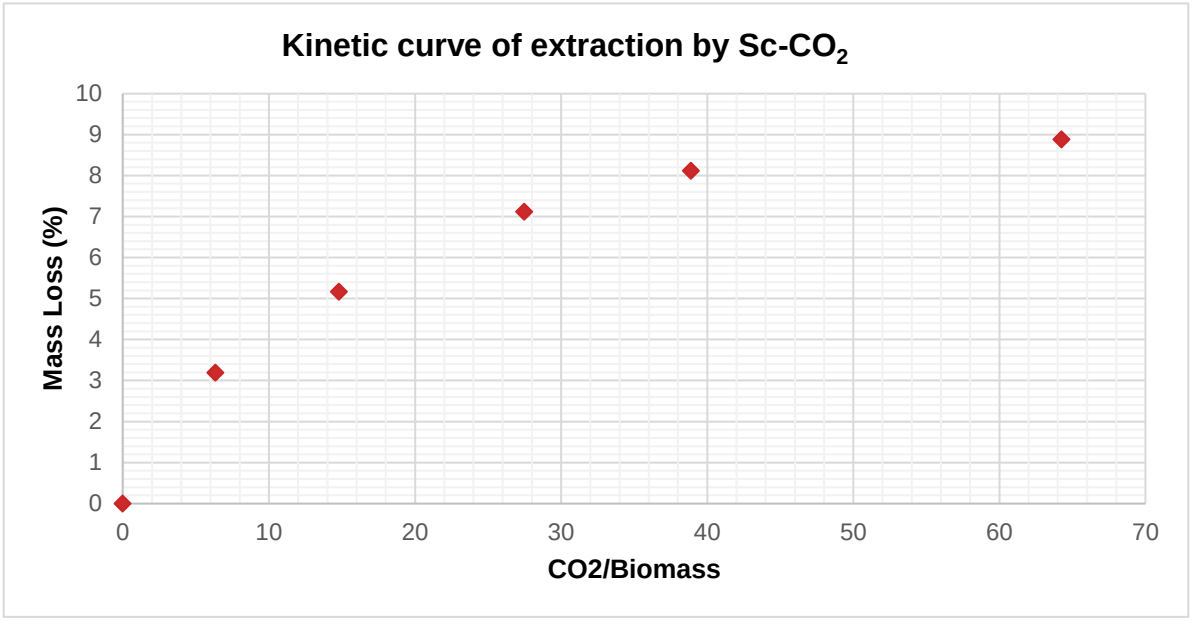
Study of the industrial transposition

Apple pomace

Some results

APPLE POMACE

CO_2 extractions



Conditions of extraction:
- T: 60°C, 400 Bar
- Mean size: 400 µm

Soxhlet extractions

Soxhlet Apparatus

Extract with n-hexane

Extract with water/ ethanol

- Solvents used: n-hexane, mixture of water / ethanol
- Freeze-dried apple pomace
- Duration 8h

Supercritical fluid extraction

Challenges for side stream valorization

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Scientific point of view

- → Stability of side stream/by-product
- → Caracterization of the compounds
- → Process Modelling
- → Development of a common process adaptable to several type of side stream

Industrial point of view

- → Stability of the side-stream/by-product
- → Costs of installations + maintenance
- → Secure the quantities
- → Logistic related to the side stream location

Supercritical fluid extraction

Opportunities for side stream valorization

- → Upcycling of side stream
- → New sources of raw materials and molecules
- → Development of innovative techniques of extractions