Pārtikas rūpniecības blakusproduktu daudzuma aplēse Eiropas Savienībā: Visaptverošs novērtējums aprites bioekonomikas sekmēšanai

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13.12.2024.

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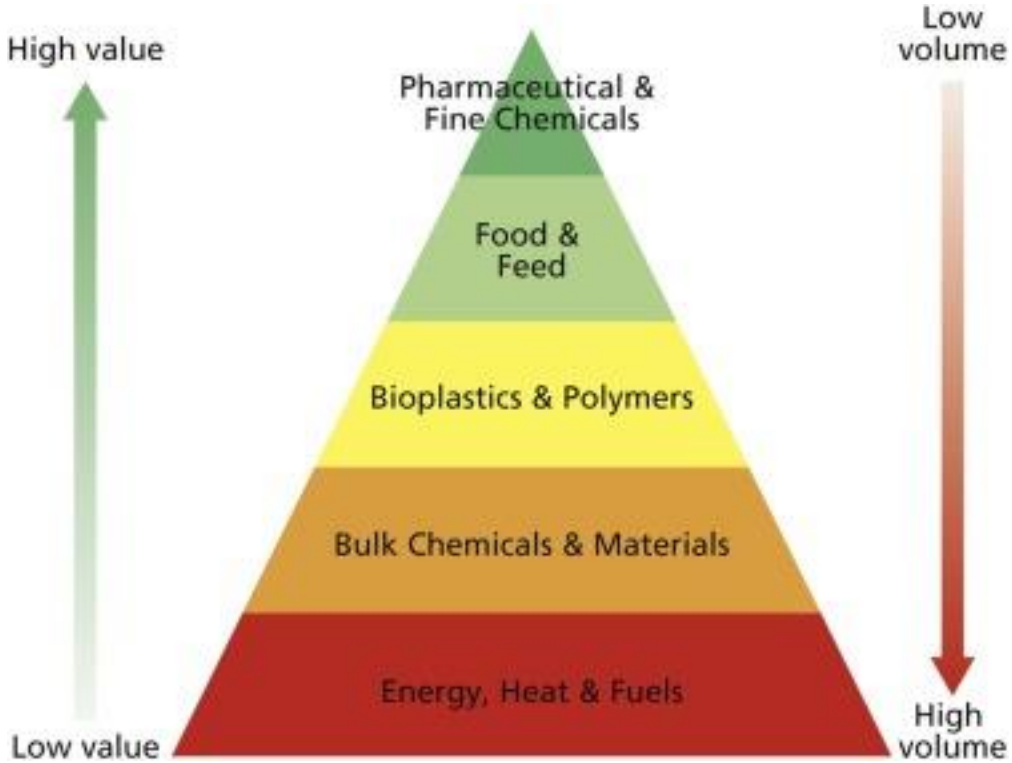
- **EU Bioeconomy Strategy[1]:**
  Circular bioeconomy aims to add value to secondary bio-resources (bio-waste and residues).
- **Stegmann et al. (2020)[2]:**
  Product value in circular bioeconomy
- **How much and what types of food industry by-products do we have for valorisation?**



Bio-based value pyramid[2]

[1]EC (2018) A sustainable bioeconomy for Europe – Strengthening the connection between economy, society and the environment. https://data.europa.eu/doi/10.2777/792130.

[2]Stegmann et al. (2020) The circular bioeconomy: its elements and role in European bioeconomy clusters. https://doi.org/10.1016/j.rcrx.2019.100029

- No data(base) exist on the amount of food industry by-products, and
- Inconsistency of the available and sporadically reported data

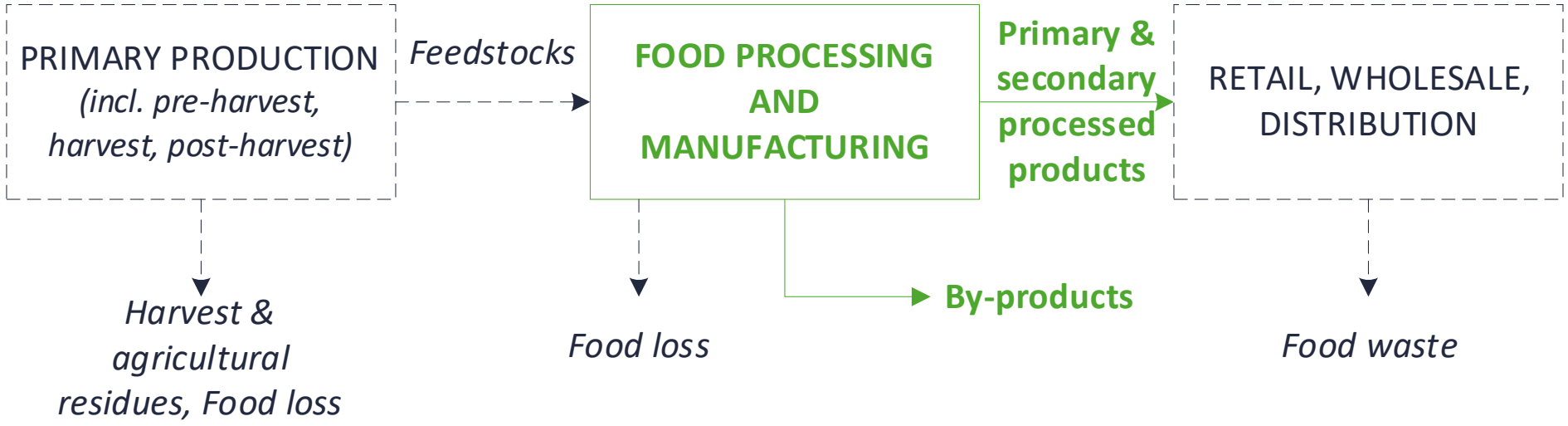
resulting from

- Lack of uniform guidelines for monitoring and measuring food industry by-products, and
- No obligation or system for reporting food industry by-products

- Hindered development of innovative bio-based product industry
- Inefficient policy- and decision-making

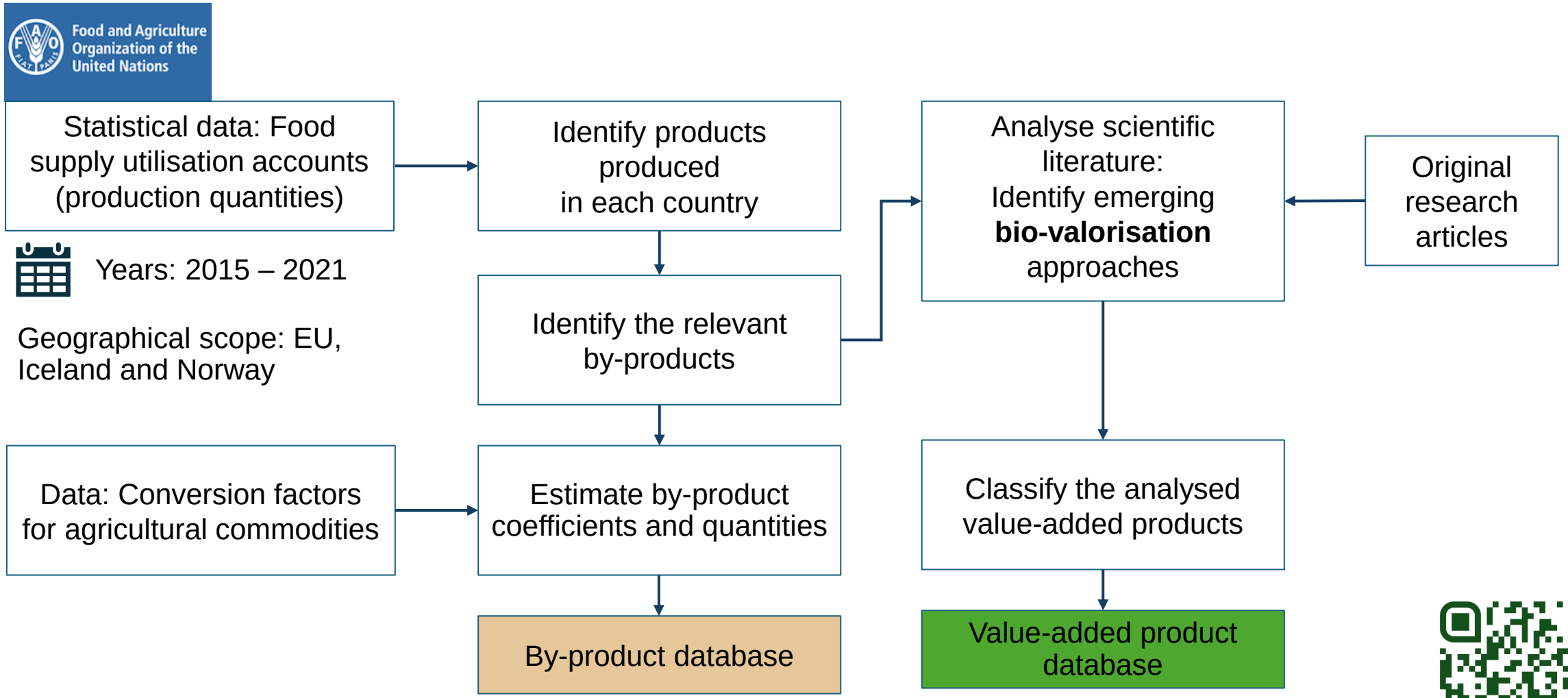
OBJECTIVES OF THE STUDY

1. To estimate the quantities of food industry **by-products** in Europe;
2. To identify the potential emerging biotechnological pathways for valorising the identified by-products into **value-added** products

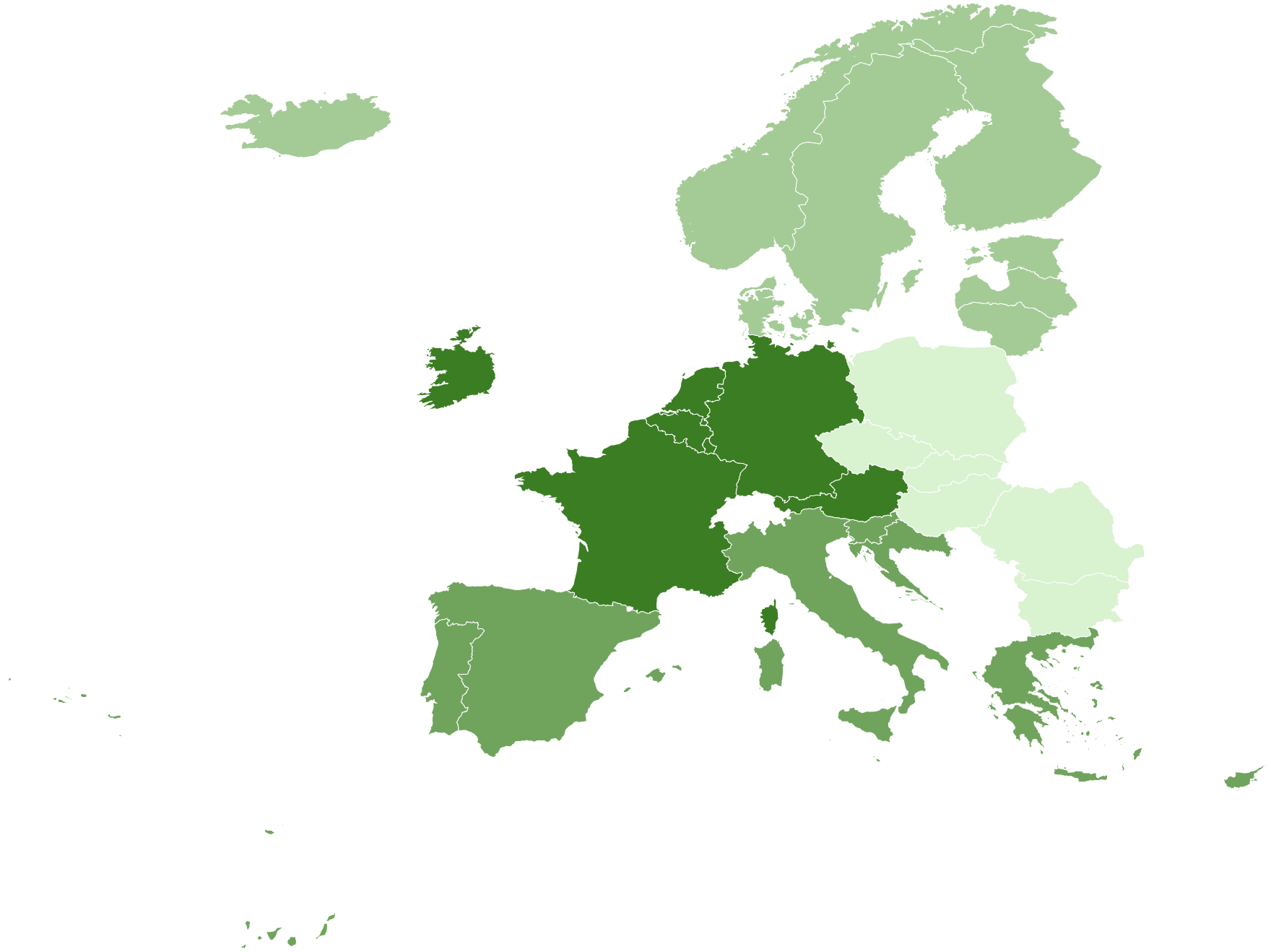


By-product – a product that is formed as an unavoidable side product in the production of food

RESEARCH METHODOLOGY[1]



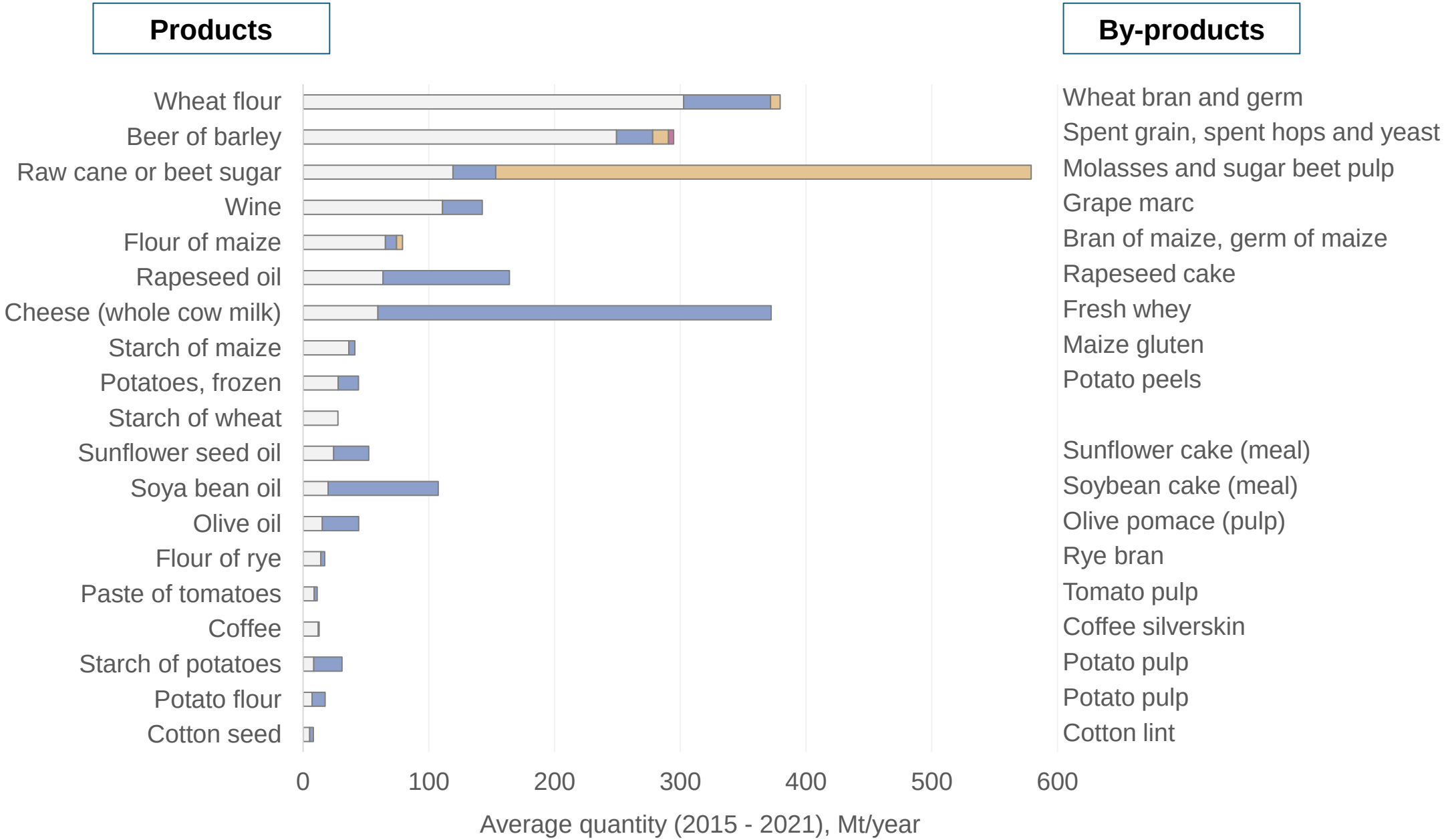
[1]Methodology in detail provided in https://doi.org/10.1007/s13399-024-05423-6



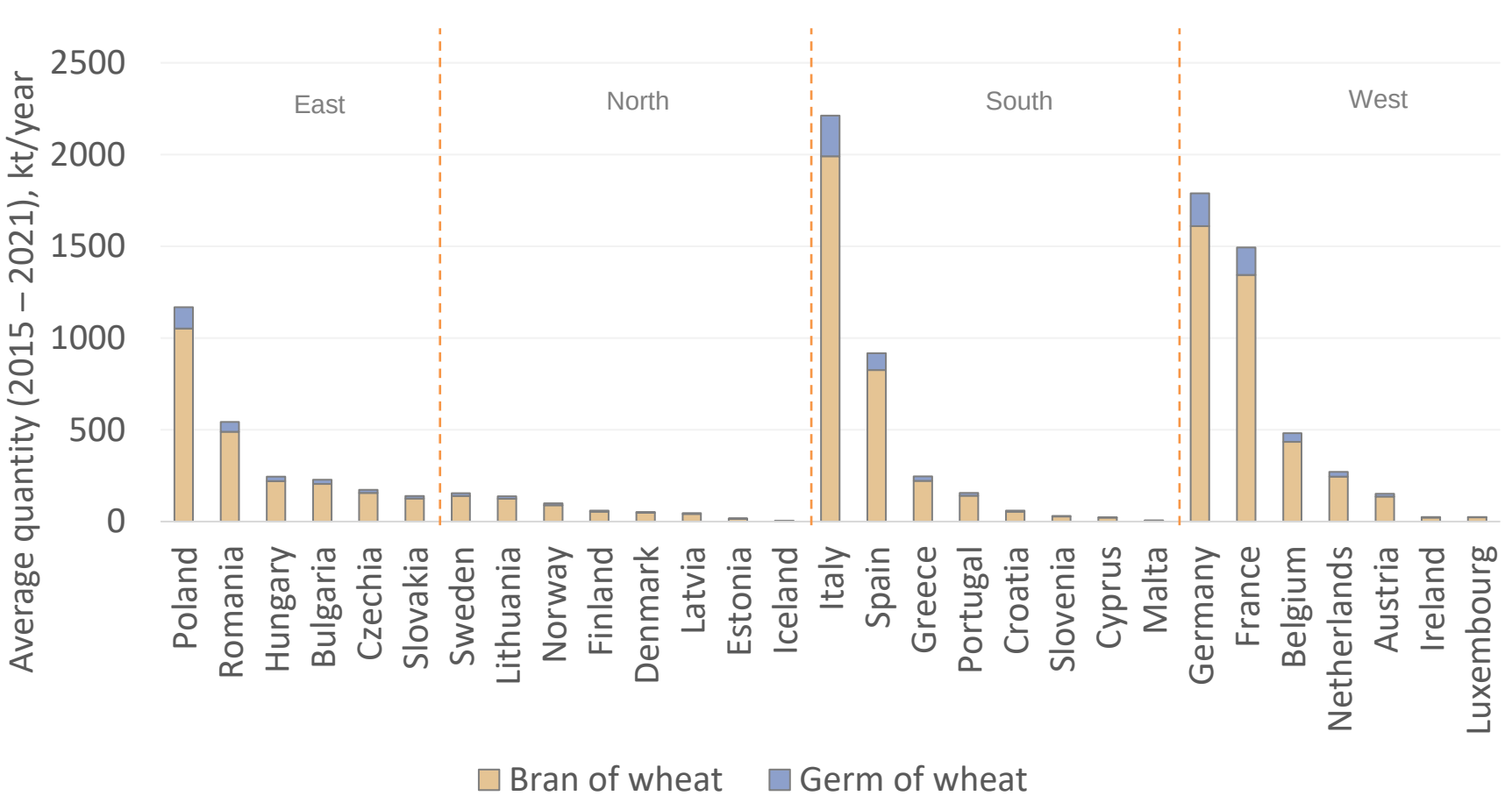
OVERVIEW OF PRODUCTS (kt/year)

Product, kt/year	North	West	East	South
Wheat flour	260	2772	1644	1803
Beer of barley	336	2748	1528	866
Raw cane or beet sugar	191	2340	682	219
Wine	4	1020	172	1407
Flour of maize	22	765	432	369
Rapeseed oil	70	1268	323	33
Cheese from whole cow milk	123	939	205	211
Potatoes, frozen	1	957	151	0.4
Starch of maize	7	434	243	260
Starch of wheat	45	463	205	38
Sunflower-seed oil	2	157	285	161
Soya bean oil	15	309	17	246
Flour of rye	39	142	152	10
Starch of potatoes	75	225	32	0.1
Olive oil	0	4	0	274
Coffee, decaffeinated or roasted	30	127	25	85
Cotton seed	0	0	2	376
Potato flour	66	135	15	1

Top 10 products in the respective region (based on average value between 2015 - 2021), kt/year


Products
By-products
Wheat flour
Beer of barley
Raw cane or beet sugar
Wine
Flour of maize
Rapeseed oil
Cheese (whole cow milk)
Starch of maize
Potatoes, frozen
Starch of wheat
Sunflower seed oil
Soya bean oil
Olive oil
Flour of rye
Paste of tomatoes
Coffee
Starch of potatoes
Potato flour
Cotton seed
Wheat bran and germ
Spent grain, spent hops and yeast
Molasses and sugar beet pulp
Grape marc
Bran of maize, germ of maize
Rapeseed cake
Fresh whey
Maize gluten
Potato peels
Sunflower cake (meal)
Soybean cake (meal)
Olive pomace (pulp)
Rye bran
Tomato pulp
Coffee silverskin
Potato pulp
Potato pulp
Cotton lint
0
100
200
300
400
500
600
Average quantity (2015 - 2021), Mt/year

BY-PRODUCTS FROM WHEAT FLOUR PRODUCTION

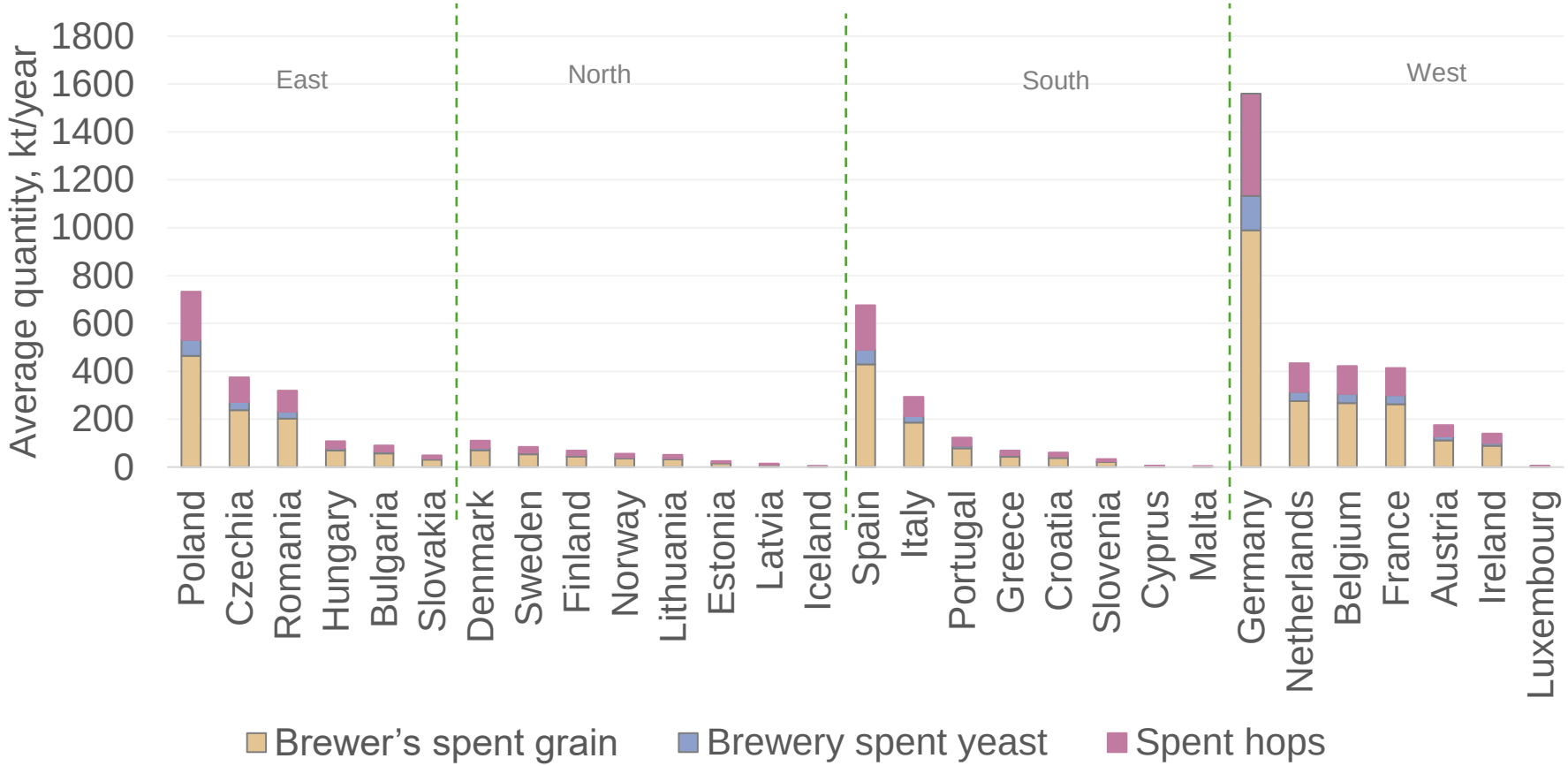


Value added products

- Acids
- Alcohols
- Antioxidants
- Enzymes
- Polymers
- Proteins
- Sugars
- Other

On average: 0.23 t of **wheat bran** and 0.03 t of **wheat germ** per 1 t of **wheat flour**

BY-PRODUCTS FROM BEER PRODUCTION

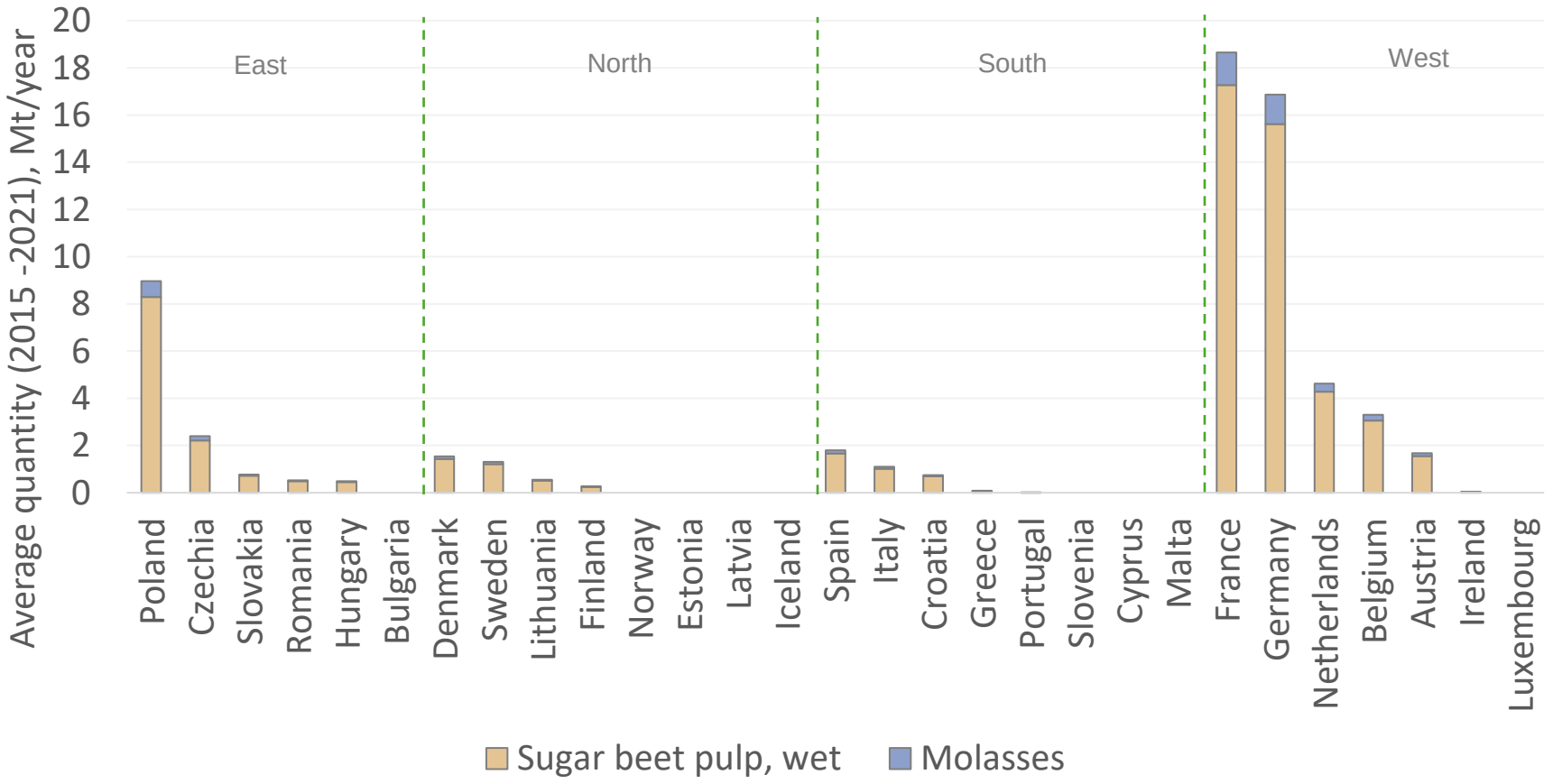


Value added products

- Acids
- Alcohols
- Antioxidants
- Enzymes
- Polymers
- Proteins
- Sugars
- Other

On average: 0.12 t of **brewer's spent grain,** 0.05 t of **spent hops** and 0.02 t of **spent yeast** per 1 t of **beer**

BY-PRODUCTS FROM SUGAR PRODUCTION



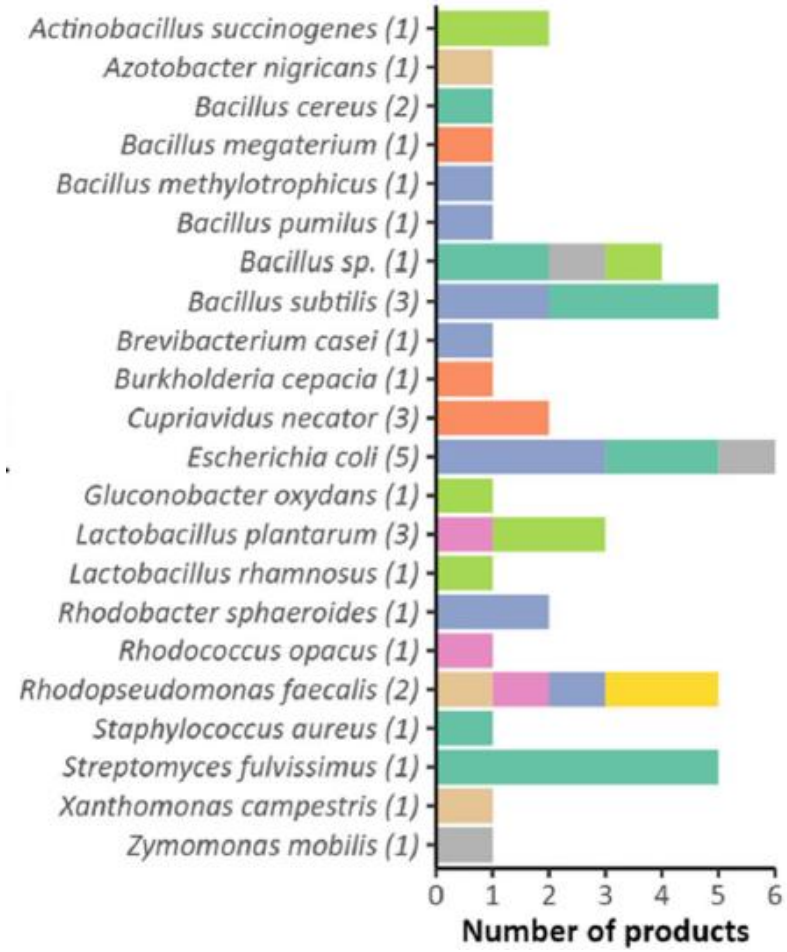
Value added products

- Acids
- Alcohols
- Antioxidants
- Enzymes
- Polymers
- Proteins
- Sugars
- Other

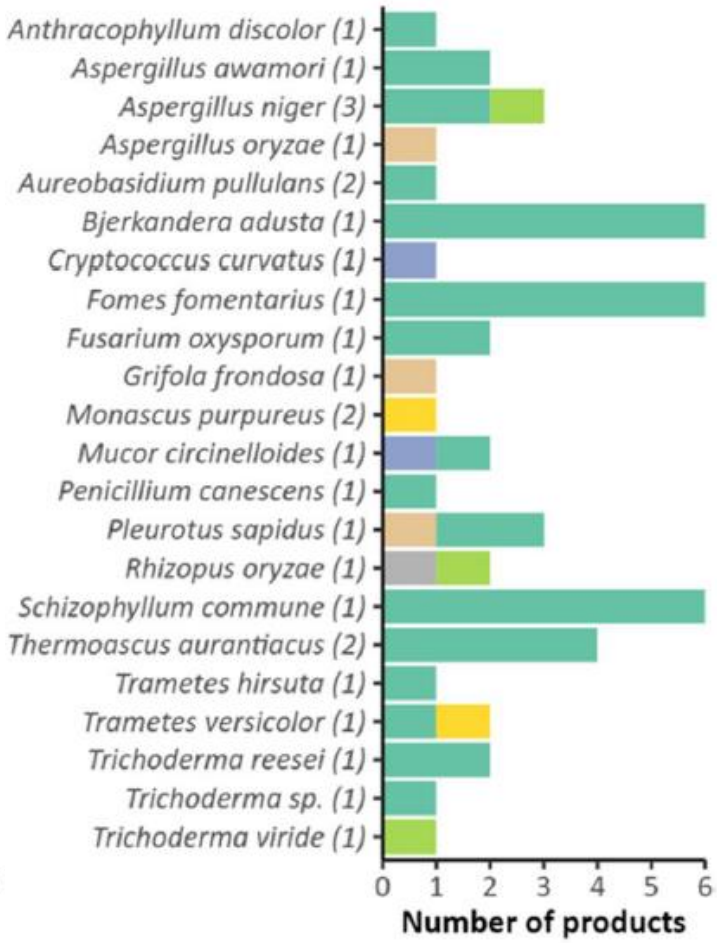
On average 3.57 t of **sugar beet pulp** and 0.29 t of **molasses** per 1 t of **sugar**.

MICROORGANISMS USED IN VALORISATION STUDIES

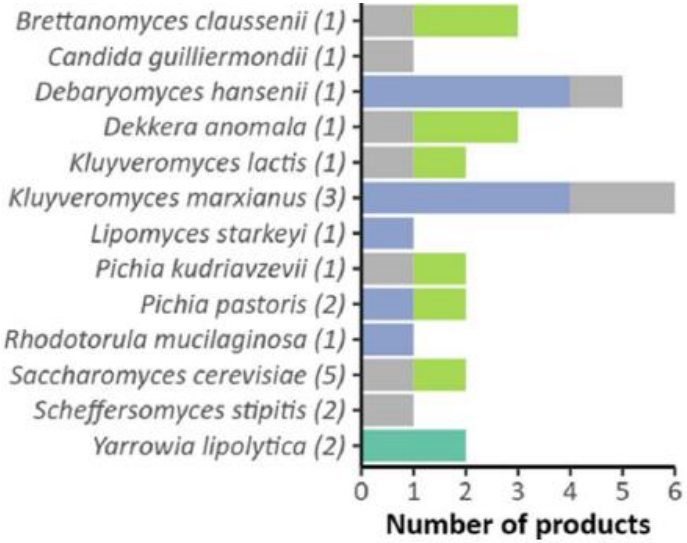
Bacteria

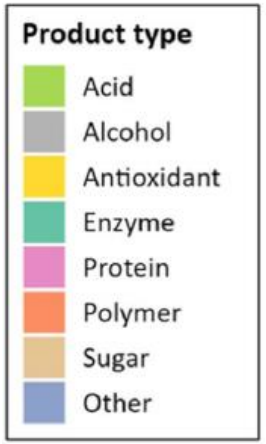


Fungi



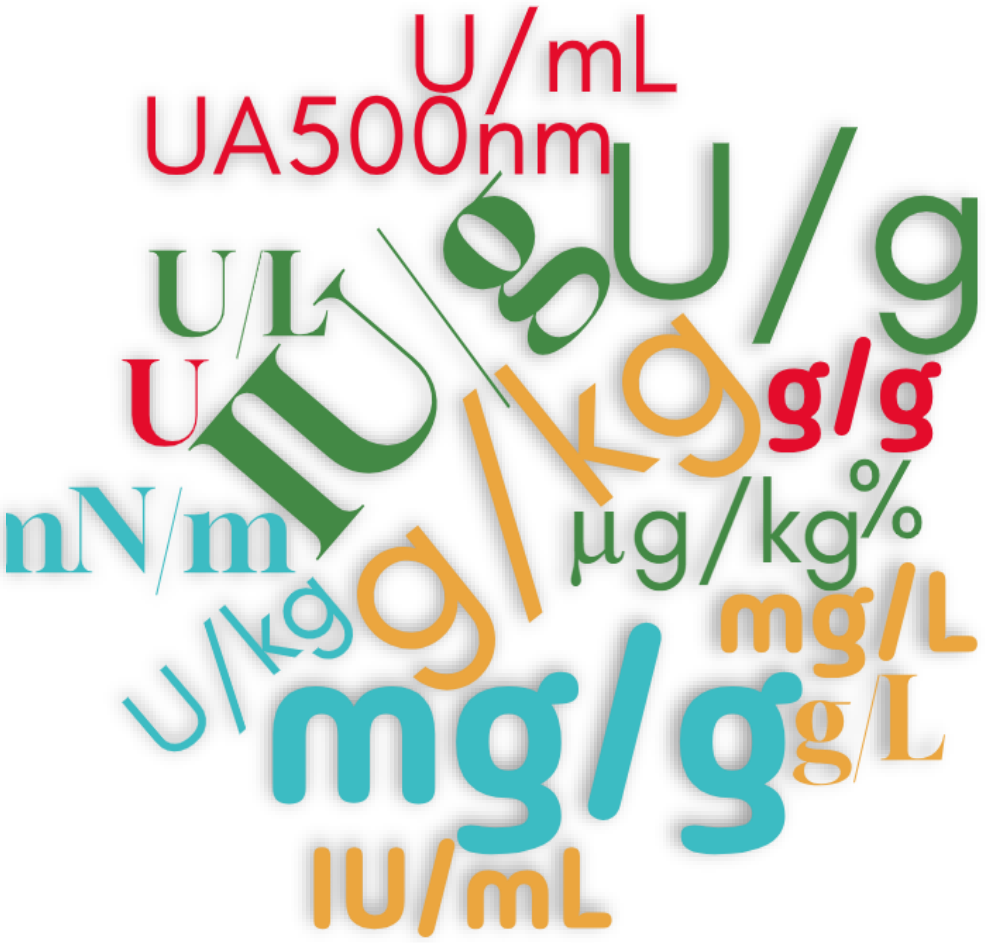
Yeast





A SMALL CRITIQUE WITH SIGNIFICANT IMPLICATIONS

- How by-product use is reported in valorisation studies
  - amount of by-product used in the fermentation medium reported as sugar equivalents
  - volume of the by-product reported instead of weight
- How units of value-added product are reported



NO OR VERY LITTLE VALORISATION RESEARCH IDENTIFIED FOR

- wheat germ
- brewery spent yeast
- spent hops
- cocoa husks
- shells
- coffee silverskin
- groundnut shells
- oat hulls
- potato pulp

TO SUMMARIZE

- Uniform method applied with a demonstrated possibility of extending the geographical scope, products and quantifiable resource flows;
- Improved data comparability and clarity on by-products;
- A comprehensive overview of by-product estimates and value-added products using bio-valorisation
- Value-added products:
  - Low technology readiness, primarily lab-scale experiments;
  - Difficult to estimate potential product quantities based on by-product availability

SPACE FOR IMPROVEMENT

- Significant **lack of data** on the amount, composition, seasonal variability, geographical distribution, and current use of by-products makes it difficult to
  (1) forecast possible valorisation capacities, and thus
  (2) choose the most appropriate valorisation solution.
- **Data availability** on by-product flows is an essential precondition to
  (1) direct research towards the most urgent and problematic by-products,
  (2) implement by-product valorisation pathways at an industrial scale, and
  (3) develop sustainable circular bioeconomy strategies at local and regional scales.
- **Assessment and comparison** of bio-based products with fossil fuel-based products considering **environmental, social and economic impacts** is necessary.

FULL DETAILS AVAILABLE IN OPEN ACCESS ARTICLE (AND ITS SUPPLEMENTARY MATERIAL)

Soloha, R., Lukaša, L.K. & Dāce, E. (2024)
Estimation and bio-valorisation of food industry by-products in Northern Europe.
Biomass Conversion and Biorefinery (Springer).
https://doi.org/10.1007/s13399-024-05423-6

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