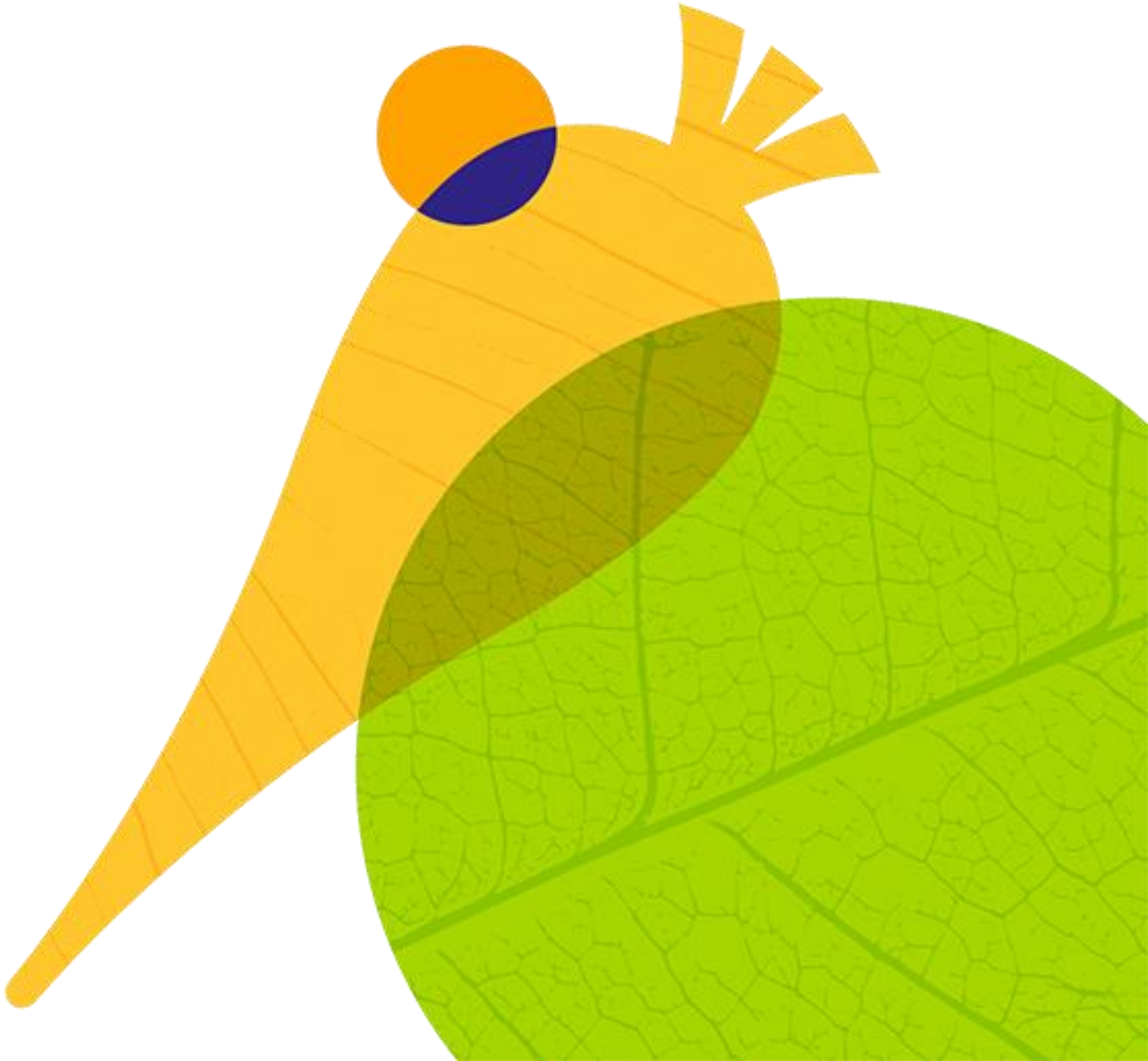
Sensus
part of Royal Cosun

Chicory as multi ingredient health booster

The sweet impact of chicory’s bitter taste



Crop Innovation & Business, March 28 2022

Matthew de Roode

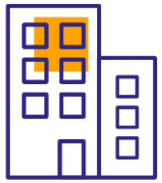
Inspired by Inulin

Sensus

- Leading supplier of **chicory root fiber** (inulin)
- Process chicory roots into **Frutafit® inulin and Frutalose® oligofructose**
- Established in 1995

500
dedicated
local farmers

2
production
sites



3
sales offices

150
employees

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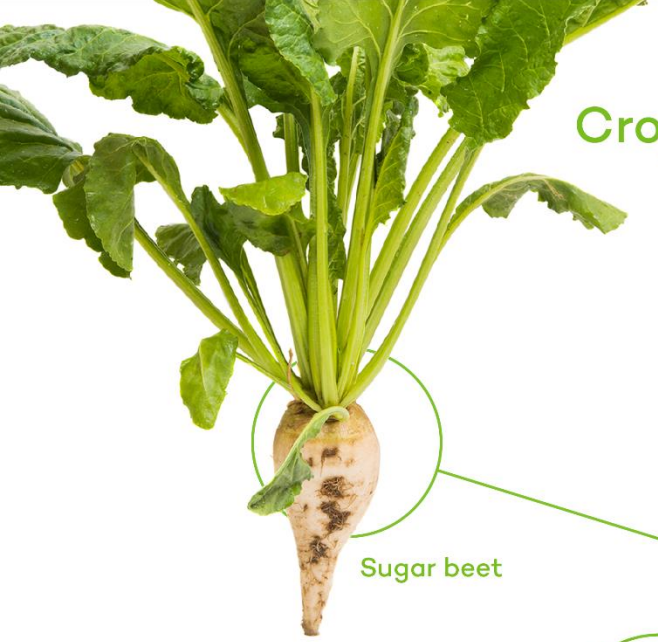
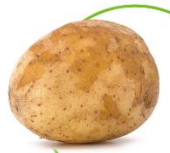
Crops → Processing and innovation → Solutions



Sugar beet



Potato

Chicory

Vegetables & Fruit

Cosun

Aviko

Cosun Beet Company

Duynie Group

Sensus

SVZ

Food

Food ingredients

Feed

Pet food

Biobased solutions

Green energy

Chicory root – an underutilised crop

- Crop competition on the Dutch arable field
  - Excluding vegetable crops
  - Photo sizes respresent the average Dutch acreage 2018-2021

Chicory
(0,6% of the
arable land)

Sensus

We believe in inulin to contribute to consumer health

Inulin is a prebiotic that is not digested in our digestive system, but completely fermented in our gut by our gut microbiota

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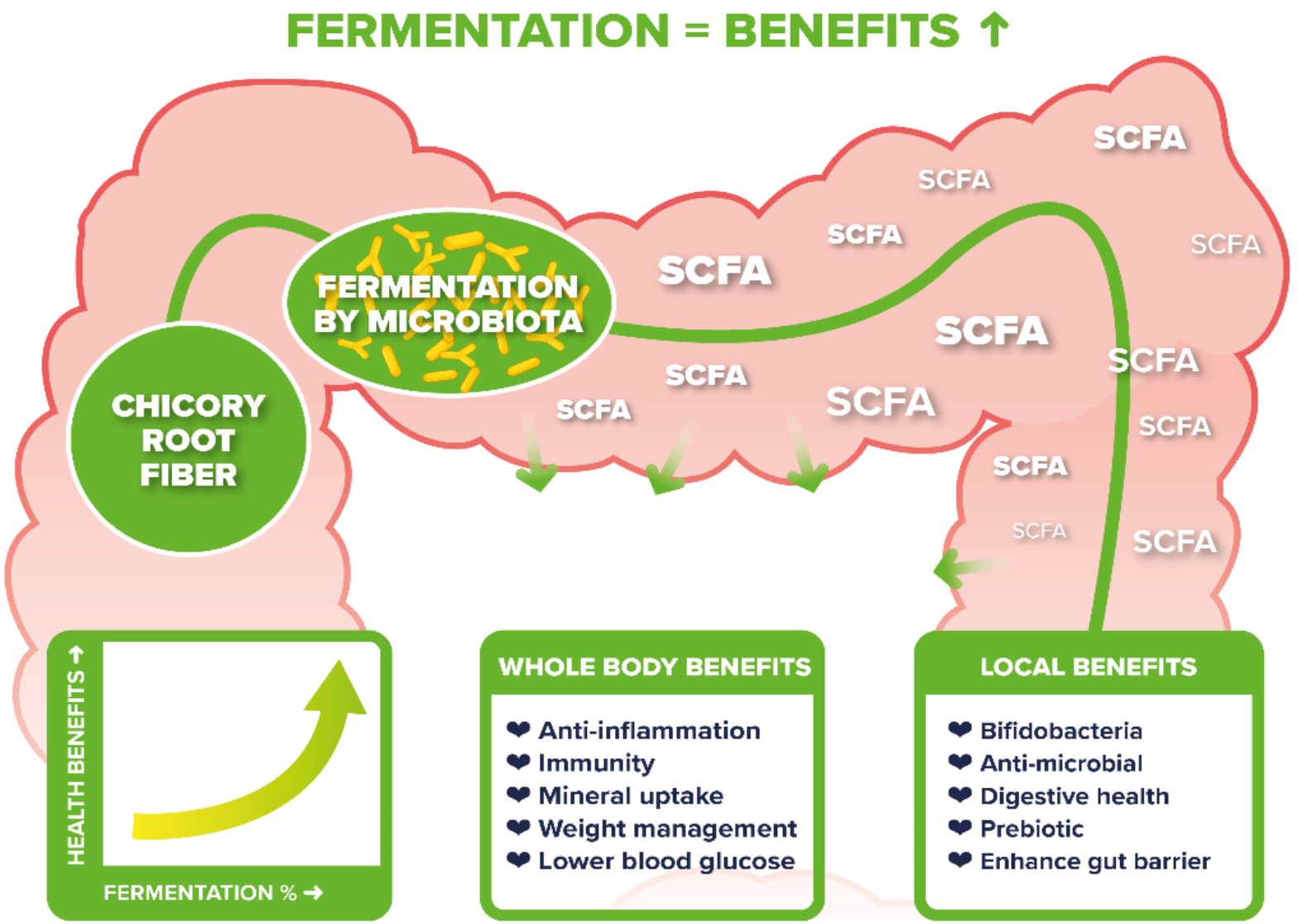
Healthy gut microbiota means healthy body



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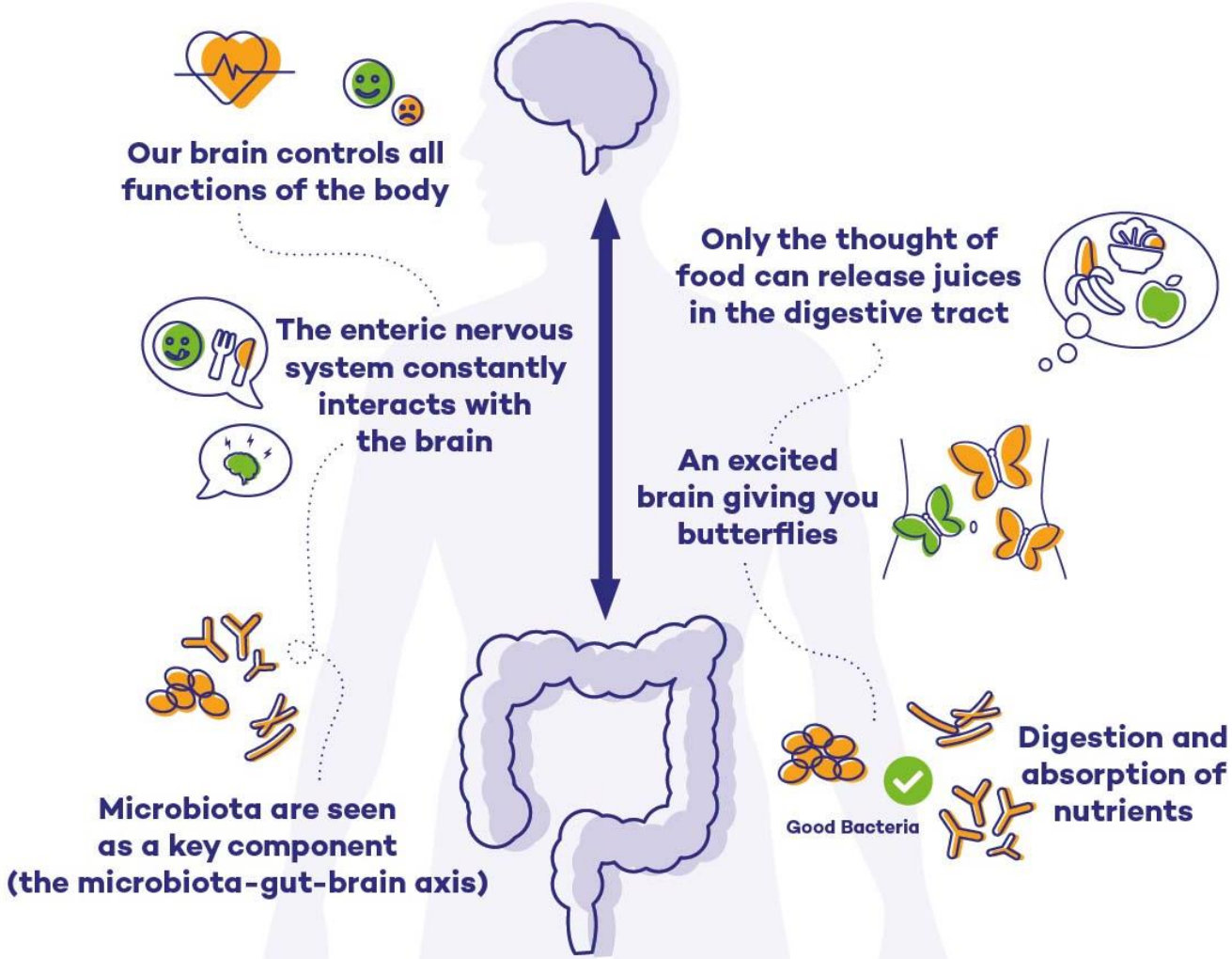
…and even a healthy brain

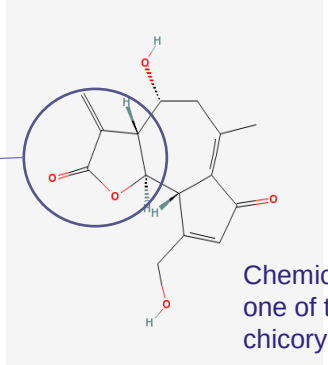


Sensus

Bitter components in chicory

- Chicory contains bitter tasting sesquiterpene lactones
- Name refers to a certain class of chemical components
  - Literally: “one-and-a-half times more (*sesqui*) terpene than lacton”

“lacton”-part that is assumed to cause the bitter taste



Chemical representation of Lactucin, one of the sesquiterpene lactones in chicory

- Secondary metabolites as defense against foraging and pests
  - Herbivores[4], Locust species *(Schistocerca gregaria)*[1], Beetle species[2], Caterpillar species[2], Nematodes (*Globodera*)[3], Fungi species[3]

1. Rees et al., Phytochemistry, 1985, 24:10, 2225-2231,
2. Jermy, Ent. Exp. Appl., 1966, 9:1
3. Nishimura et al., Journal of Chemical Ecology, 2000, 26:9, 2233-2241
4. Foster et al, J. Agric. Food Chem., 2006, 54, 1772-1778

Sensus

Potential of SL's - Anthelmintic

- Anti-parasitic action of chicory has been known for a long time
- …but chicory contains at least 12 different SL's

- Research at the University of Copenhagen
  - Predominant SL's with a synergistic action identified
  - PhD defence coming Friday!

ELSEVIER
International Journal for Parasitology: Drugs and Drug Resistance
Volume 15, April 2021, Pages 105-114

Identification of compounds responsible for the anthelmintic effects of chicory (*Cichorium intybus*) by molecular networking and bio-guided fractionation

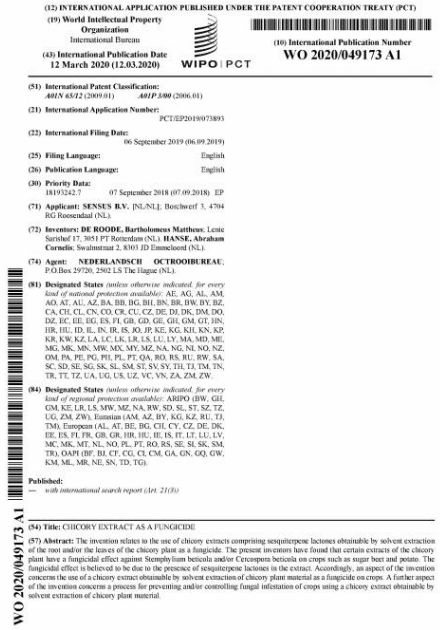
Angela H. Valente [a], Matthew de Roode [b], Madeleine Ernst [c], Miguel Peña-Espinoza [d], Louis Bornancin [e], Charlotte S. Bonde [a], María Martínez-Valladares [f], Sabrina Ramünke [g], Jürgen Krücken [g], Henrik T. Simonsen [e], Stig M. Thamsborg [a], Andrew R. Williams [a]

Sensus

Potential of SL’s – Crop protection

- SL-stream was concentrated with mild technologies
  - Rich in sesquiterpene lactones
  - Process and product patented
- Activity against *Stemphylium* and *Cercospora* on sugar beet
  - No significant difference with two commercial products in climate chamber tests
  - Significantly better performance than no treatment in field tests
  - Effective dosis 1 g/ha

Photo: IRS



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(54) Title: CHICORY EXTRACT AS A FUNGICIDE

(57) Abstract: The invention relates to the use of chicory extracts comprising sesquiterpene lactones obtainable by solvent extraction of the root and/or the leaves of the chicory plant as a fungicide. The present inventors have found that certain extracts of the chicory plant have a fungicidal effect against Stemphylium beticola and/or Cercospora beticola on crops such as sugar beet and potato. The fungicidal effect is believed to be due to the presence of sesquiterpene lactones in the extract. Accordingly, an aspect of the invention concerns the use of a chicory extract obtainable by solvent extraction of chicory plant material as a fungicide on crops. A further aspect of the invention concerns a process for preventing and/or controlling fungal infestation of crops using a chicory extract obtainable by solvent extraction of chicory plant material.

Potential of SL's – Anti inflammatory

- Project CHIC
  - A EU-funded project to investigate new breeding techniques (CRISPR-cas9)
  - Chicory as case study because of its interesting health promoting properties

- The SL's activity has been assesed from a pharmaceutical viewpoint
  - Anti inflammatory activity has been shown in *in vitro* tests
  - Antifungal activity (Candida species) has been shown in *in vitro* tests

molecules

Article

Supercritical CO_2 Extraction as a Tool to Isolate Anti-Inflammatory Sesquiterpene Lactones from *Cichorium intybus* L. Roots

João P. Baixinho [1,†], José D. Anastácio [1,2,†], Viktoriya Ivasiv [1], Katarina Cankar [3], Dirk Bosch [3], Regina Menezes [1,2], Matthew de Roode [4], Cláudia Nunes dos Santos [1,2], Ana A. Matias [1] and Naiara Fernández [1,*]

Stakeholder communication

- Communication in this project is key
  - CRISPR-cas9 techniques are perceived with reservations and face regional restrictive regulations
- Stakeholder dialogue meetings to investigate the opinion towards these techniques
  - Growers, ingredient manufacturers, food producers, consumer groups, NGO's & governmental organizations were and are still actively involved
  - Current feedback (panels were prompted with different scenarios)
    - If the EU keeps considering these techniques as GMO
      - No application in food is foreseen
      - Medicinal applications are seen as acceptable
    - As soon as the EU does not consider these techniques as GMO, no application hurdles are foreseen

Take outs

- Albeit being a small commercial crop
  - Chicory root is the source for inulin, an established health ingredient
  - Its secondary metabolites enable even more potential in health applications

- Sensus is involved in a broad spectrum of research projects
  - To investigate the commercial potential of these health applications
  - To support an increased focus of chicory on the fields

Sensus