

## Malting of wheat offers the opportunity for producing nutritious and clean label breakfast flakes

Elien Lemmens<sup>1</sup>, Lomme J. Deleu<sup>1</sup>, Niels De Brier<sup>1</sup>, Erik Smolders<sup>2</sup> and Jan A. Delcour<sup>1</sup>

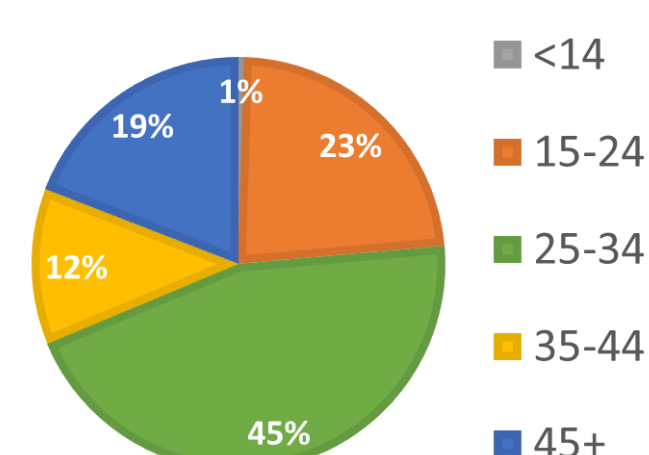
<sup>1</sup>Laboratory of Food Chemistry and Biochemistry and Leuven Food Science and Nutrition Research Centre (LFoRCe), KU Leuven, Belgium

<sup>2</sup>Division of Soil and Water Management, KU Leuven, Belgium

### What do consumers value about breakfast cereals?

**TASTE** PACKAGE-FREE STORE  
**NO ADDED SUGAR** ADDITIVES  
UNIQUE FLAVOR WHOLE GRAIN  
SUPERMARKET VITAMINS  
OATS MORE FIBERS **FLAKES**  
ATTRACTIVE PACKAGING  
LOCALLY CULTIVATED  
ONLINE SELL GRAINS MIXTURE

Survey spread via social media in 2022  
> 580 mainly Belgian participants



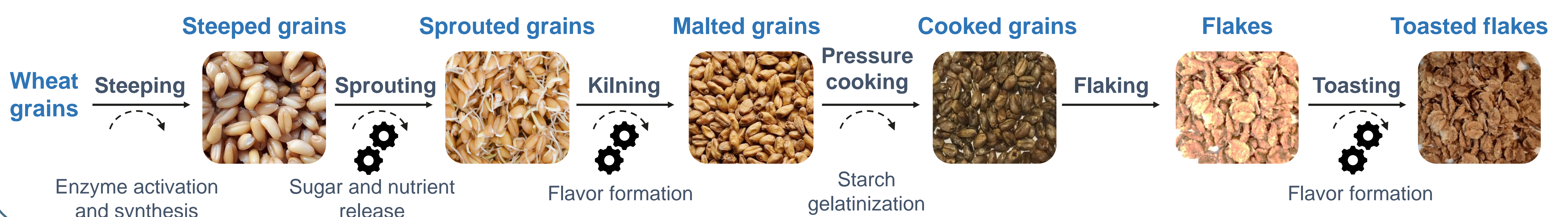
### The opportunity

Wheat malting initiates seedling growth and *de novo* synthesis of enzymes to make nutrients available for plant development and, when used in food systems, for human uptake. The malting process results in [1]:

- The formation of intrinsic sugars (see Figure 1) which deliver sweet notes to foods and serve as precursors in the Maillard reactions (caramel and toast aromas).
- The formation of flavour compounds (mainly aldehydes and alcohols delivering cocoa, honey-like floral and nutty aromas: see Figure 2).
- A substantial increase in concentrations of B vitamins and  $\gamma$ -amino butyric acid (GABA).
- The release and hence a greater accessibility of minerals (see Figure 3).
- The transformation of part of the insoluble into soluble dietary fiber.

[1] Lemmens, E. et al. (2019), CRFSFS 18, 305-328

### Production process of 100% whole grain malted flakes



### Sensorial analyses

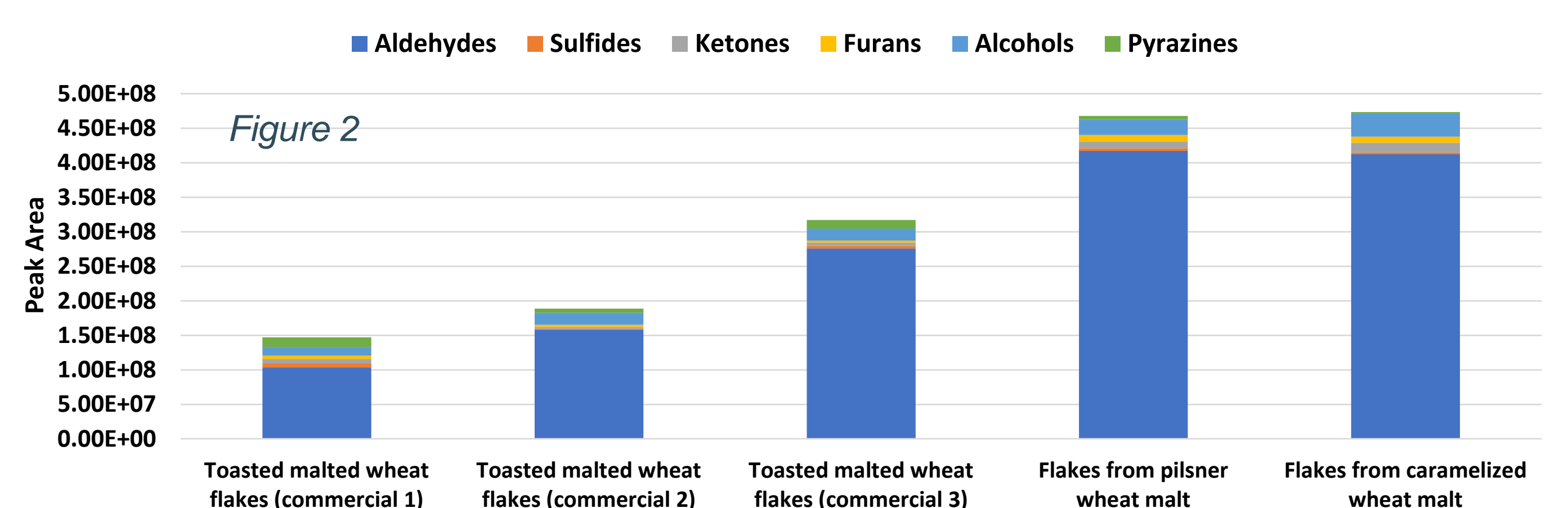
92% differentiated between flakes from Pilsner wheat malt and regular whole wheat flakes made in a similar way without added sugar

86% Preferred the taste and texture of flakes from Pilsner wheat malt over regular whole wheat flakes

73%  
84%

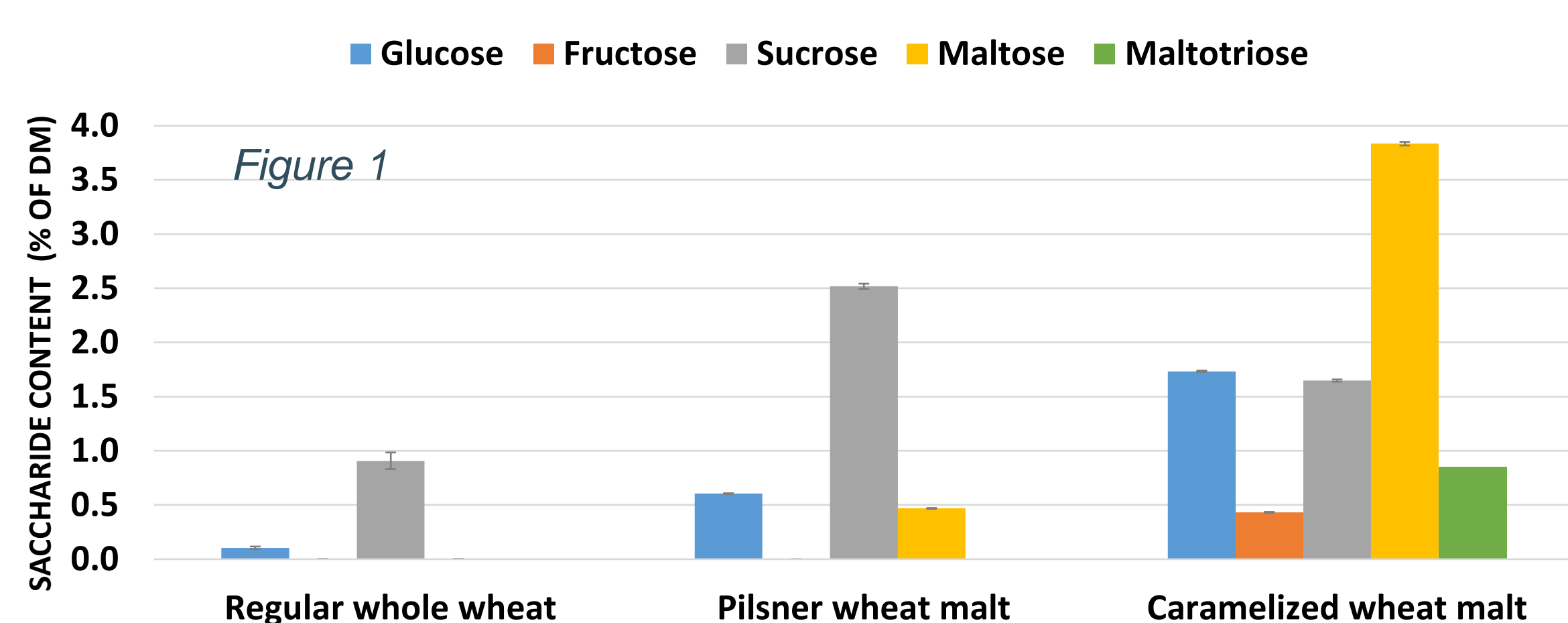
24 participants in Belgium, 22 participants in France

### Volatile aroma compounds



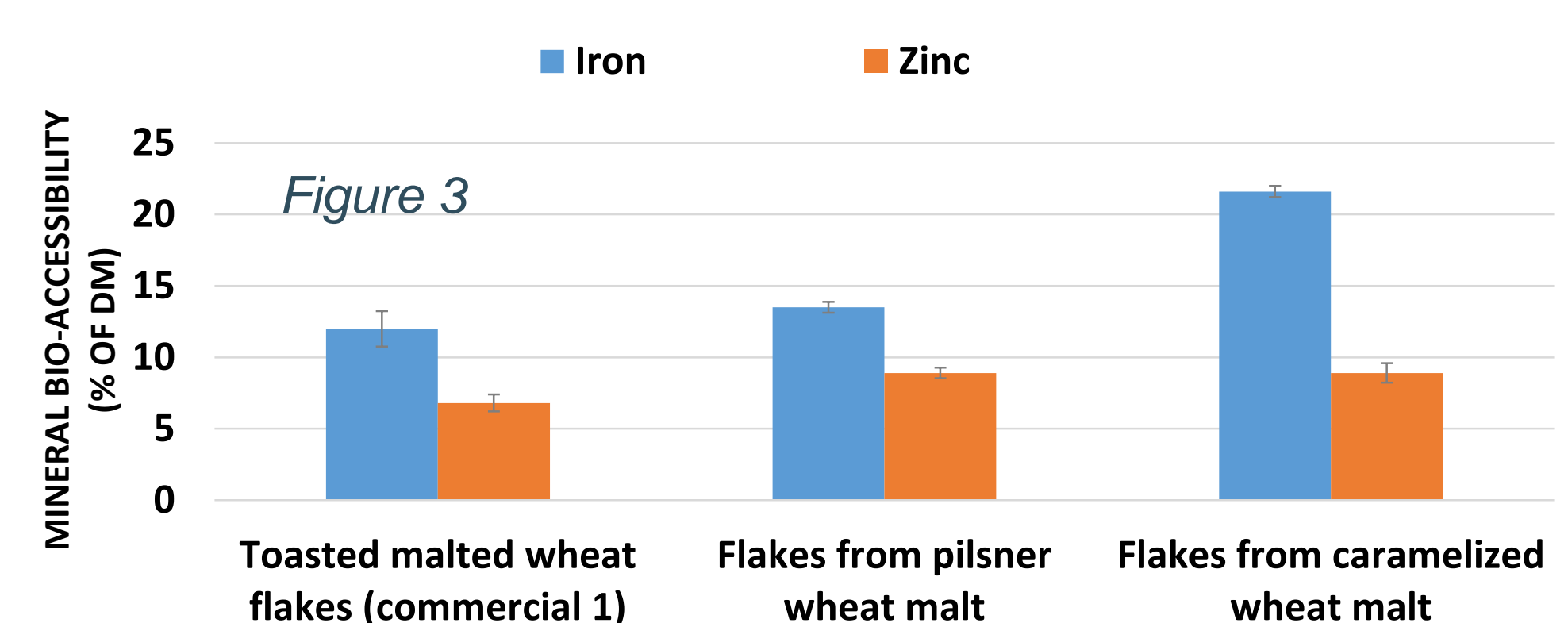
Analyses were performed using headspace-solid phase micro extraction in combination with GC-MS. The total area of volatile compounds present in flakes from Pilsner malt and caramelized malt are comparable but significantly higher than that of all commercial flakes tested. The aldehyde fraction (70.5 – 89.0%) is relatively the highest compared to all other chemical compound classes studied.

### Saccharide composition



The soluble saccharide content was quantified using High Performance Anion Exchange Chromatography (HPAEC) with Pulsed Amperometric Detection (PAD). By allowing the starch degrading enzymes to be active during wheat malting, the total saccharide level in the flakes made thereof is tunable (4 to 9% of dm). As a result, a 6-fold increase in relative sweetness can be obtained compared to regular whole wheat.

### Iron and zinc bio-accessibility values



The mineral bio-accessibility (*i.e.* amount of iron and zinc that is released from the food matrix) was determined using an *in vitro* digestion procedure followed by mineral quantification with Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Surprisingly, the iron and zinc bio-accessibility values of the flakes derived from wheat malts were largely comparable to those of the commercial flakes. Still, the iron bio-accessibility in flakes derived from caramelized wheat malt amounted to 22%, highly likely due to phytate hydrolysis as a result of phytase action during malting.

### Conclusion

We developed a whole grain and grain only flake with a unique flavor profile and an unlocked health and wellbeing potential as its production process has for example boosted the accessibility of iron. At the same time, the *de novo* synthesized saccharides kick out the empty calories out of the common standard recipes for sweet breakfast cereals.