



An introduction to Royal DSM

A purpose-led science-based company active in
Nutrition, Health and Sustainable Living

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HEALTH · NUTRITION · MATERIALS

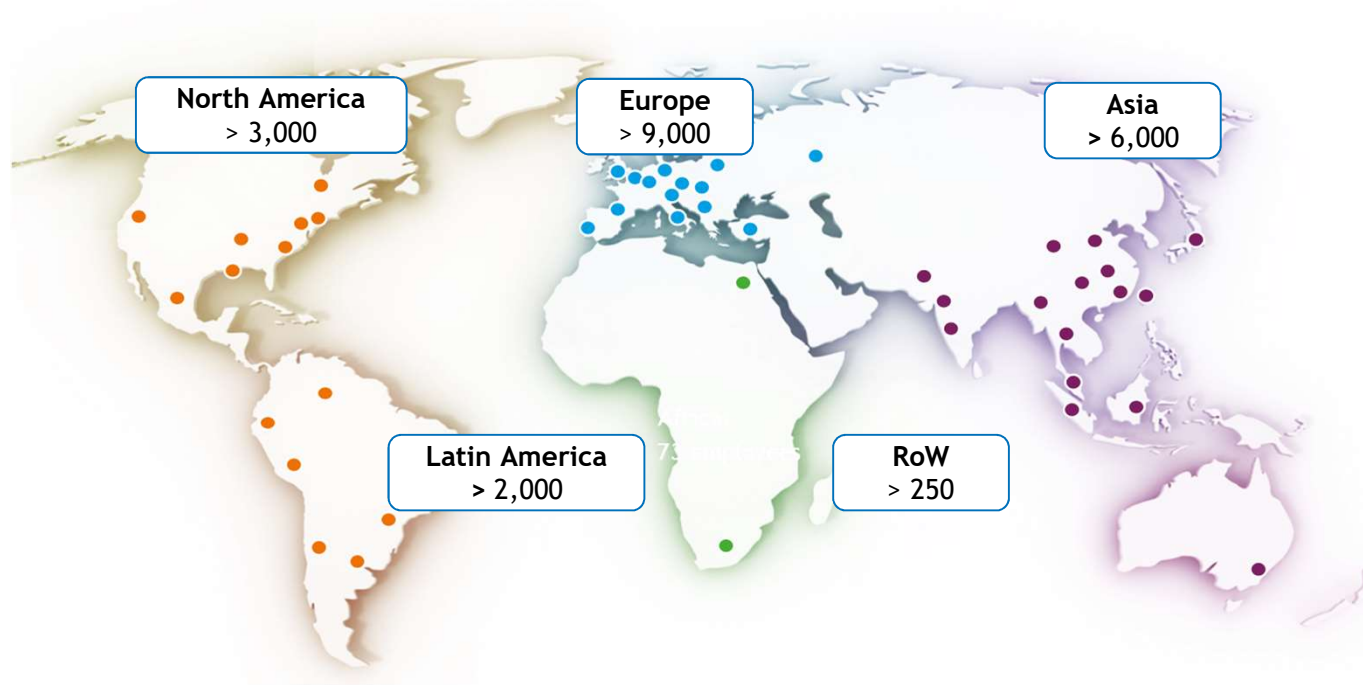
Successful transformation future-proofing DSM

Coal mining (Petro)chemicals Nutrition, Health & Sustainable Living



DSM workforce

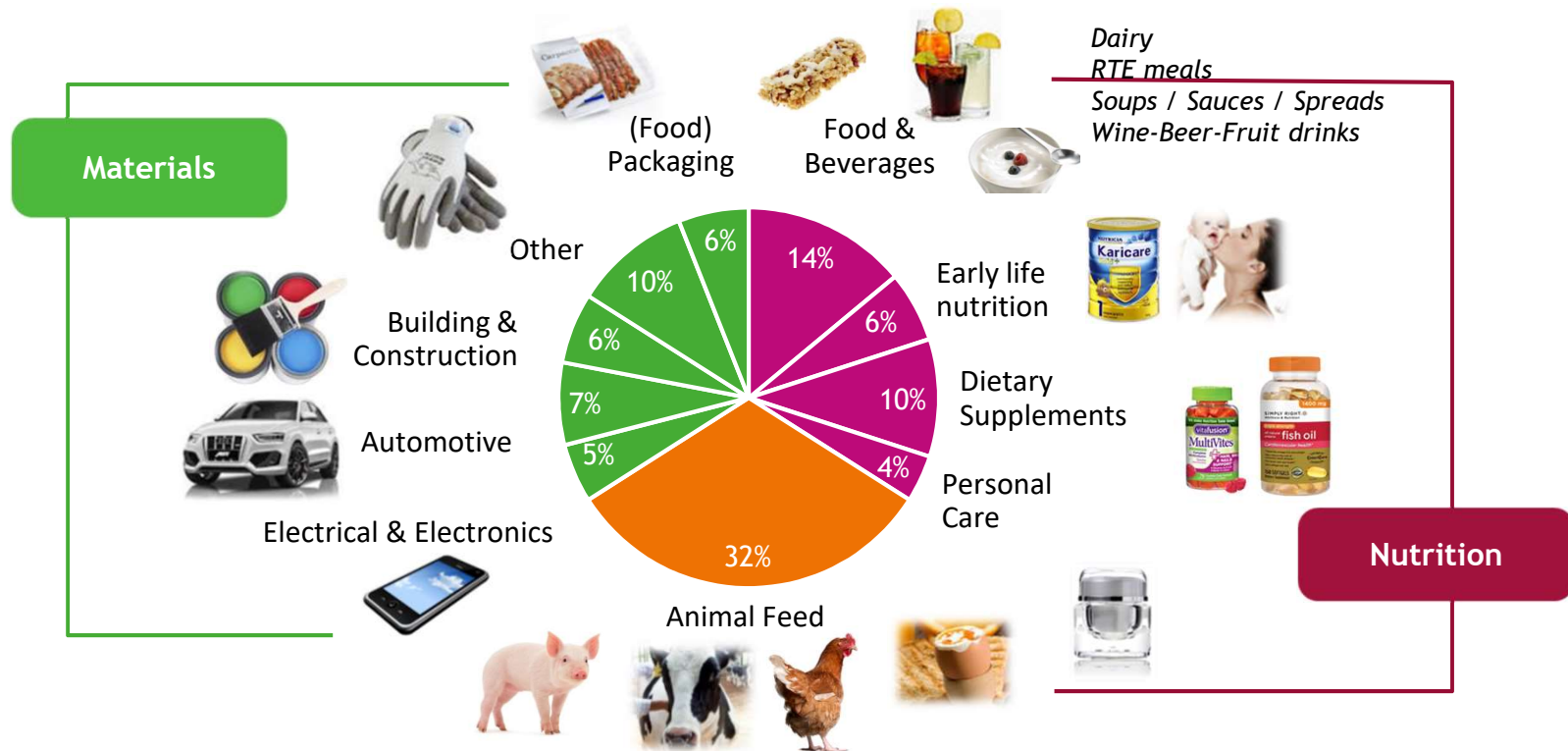
Global workforce (FTE)



~ 60%
employees
outside Europe

~24,000 employees incl. JVs/Associates

DSM offers products & solutions to a wide range of end-markets



DSM Food Specialties

WE PRODUCE
INGREDIENTS &
PROCESSING AIDS
FOR
MANUFACTURERS
WHO PRODUCE THE
WORLD'S BEST
LOVED BRANDS

- ✓ Food enzymes
- ✓ Cultures
- ✓ Food protection
- ✓ Bio-preservation
- ✓ Yeast extracts
- ✓ Process flavors
- ✓ Taste modulators

 Sugar reduction	 Taste Experience	 Health & Wellness	 Bio- Preservation	 Food Chain Efficiency
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SERVING CUSTOMERS IN


Dairy
Baking
Beverage
Savory
Worldwide
Production
Scientific Research
& Innovation
Global Sales and
Regulatory
Expertise
Application
Know-how

ENABLING
BETTER FOOD FOR
EVERYONE



IS OUR PURPOSE

- ✓ Healthier
- ✓ Convenient
- ✓ Tasty
- ✓ Indulgent
- ✓ Available
- ✓ Affordable
- ✓ Sustainable

We help our customers get to market faster with solutions that add value for them and their consumers

Effective in vitro degradation of gluten for gluten intolerant people

By A. Bruchmann

Introduction

- It was not so long ago that milk substitutes made from cereals, soy, nuts and almonds had a scorned existence in the far corner of the organic shop.
- In the meantime, the drinks occupy entire shelves in the supermarket and at the discounter.
- In addition to health reasons, more and more economic and environmental aspects are contributing to the purchase decision.

Plant-based drinks are becoming increasingly popular

- The market research institute Innova recorded that **\$ 16.3 billion** have been generated worldwide from plant-based drinks in 2018.
- In 2010 there were **7.4 billion**.
- The sales markets **grow by around 12%** per year.
- This is not due to the vegetarian or vegan people, whose number is only growing slowly, but the so-called flexitarians - people who do not completely do without animal products, but consciously reduce their consumption.

Different reasons to consume plant-based beverages



Animal welfare



Environment



Milk allergies



Taste!



(Ovo) vegan



Health



Religion

Raw materials



- **SOY**
- The cultivation of soy is problematic when it is done industrially.
- The EU imports around 35 million tons of soybeans a year - more than half of them from Brazil.
- There, huge fields displace the rainforest and pollute the soil and groundwater.

- **ALMONDS**

- Almond drinks are the second most popular alternative in America and Europe.
- 80% of the almonds processed worldwide come from California.
- There are also huge monocultures that leave no room for the original flora and fauna.



- **RICE**

- Rice drinks have a rather watery consistency and a clearly sweet rice taste.
- Rice is grown in both Europe and Asia.
- However, due to water consumption and greenhouse gas emissions, the ecological balance of rice looks less good.



- **OATS**

- Oats have the home advantage
- Oat cultivation has always been common in Europe, so the question of rainforest deforestation and irrigation does not arise as in the California desert.
- For example, the Swedish company Oatly® only uses oats from its own country.

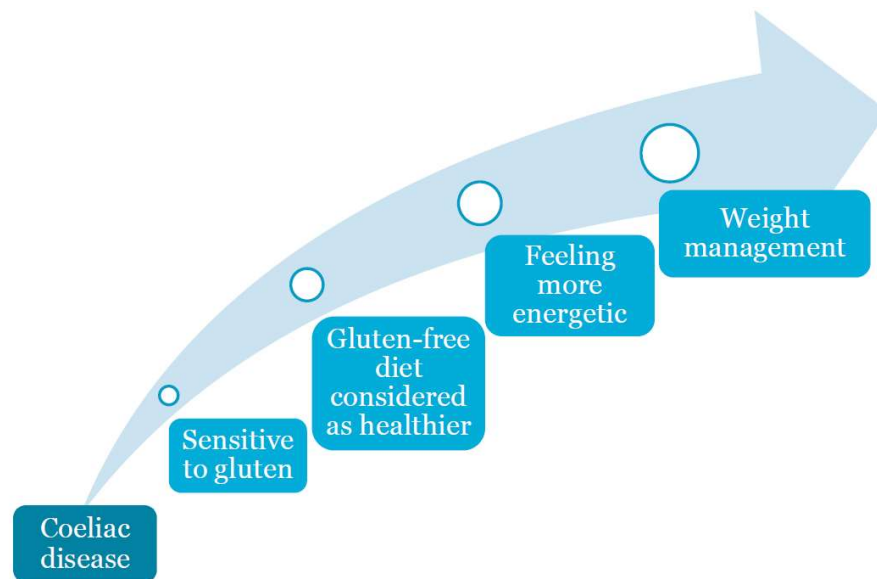


So, oats have several (dis)advantages!

- Oat (*Avena sativa*), sometimes called the common oat, is a species of cereal grain grown for its seed, which is known by the same name. Oats are suitable for human consumption as oatmeal and rolled oats. Oats are a nutrient-rich food associated with lower blood cholesterol when consumed regularly.
- For the production of oat drinks, mainly oat flour or oat flakes are used.
- There is only one disadvantage of oats as a raw material, it contains gluten.
- Oats doesn't contain naturally gluten, but international traded oats are always cross-contaminated especially with wheat and other gluten-containing grains (contamination-levels of 5-10% are internationally accepted)
- International, conventional oats are available at prices of around **720€/t**
- There is also “gluten-free” oat available on the European market with a (actual, but drastically increasing) price of **1.100€/t**
- If you want to produce a “gluten-free” oat drink, you have to purchase gluten-free oats for a higher price (+35%), or you ask us!



Gluten-Free consumption stretches beyond allergies



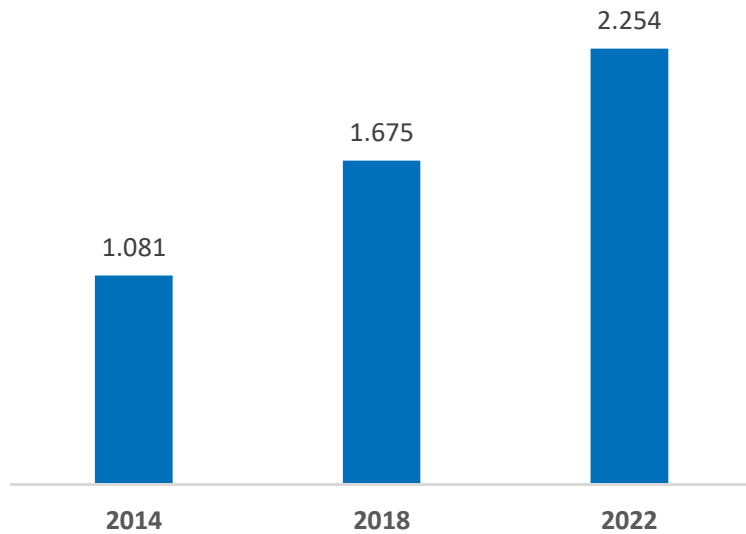
Source: Euromonitor International

Page 11



Strong growth expected to continue for the future

Retail value Gluten-Free food & beverages Europe
(million Euro)



Source: Euromonitor International

Page 12

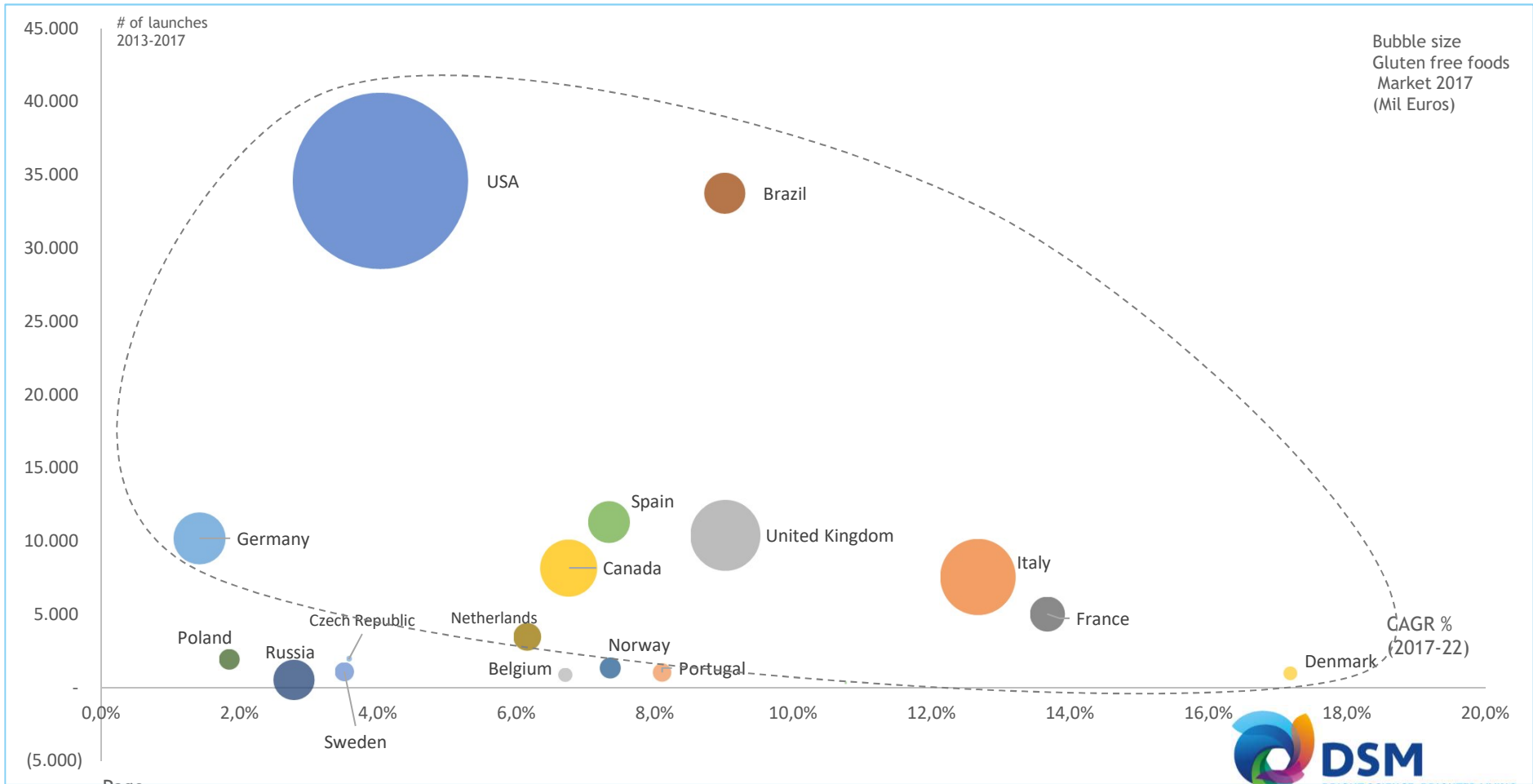


Gluten-Free is a growing segment in the beverage industry



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Gluten free foods mapping- Countries with sizeable market or with a high growth



Page

When is food considered to be Gluten-Free?

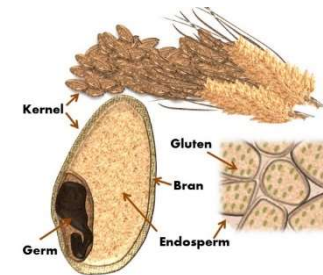
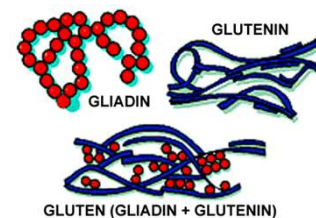
Gluten-Free food labelling to help consumers make choices

- Gluten levels of < 20 ppm low enough to protect even the most sensitive individuals
- Foods labeled Gluten-Free, without gluten, free of gluten, no gluten should contain gluten \leq 20 ppm (mg/kg)
- In Europe, there is also a “very low gluten” category (21-100 ppm)
- **Codex Recommended testing methods:**
 - Enzyme-linked immunosorbent assays (ELISA)
 - R5 ELISA for gliadin (R-Biopharm®)
 - Wheat Protein ELISA Kit for gliadin (Morinaga Inst. of Biological Science)
- FDA/TTB: considering ELISA for hydrolyzed / fermented foods (incl. beer)



What is gluten?

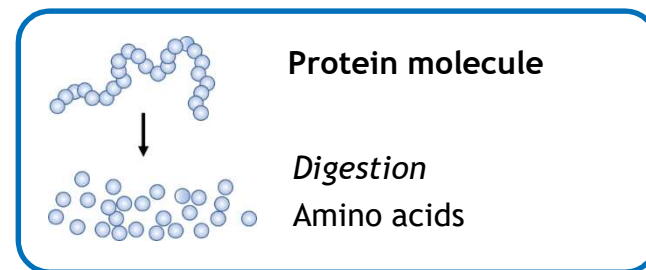
- Latin gluten: “glue”
- Gluten are storage proteins in wheat, barley, rye and possibly oats
- In wheat: Gliadin and Glutenin
- In barley: Hordein
- Also named Prolamins:
 - Gluten proteins contains 15-20% of Proline amino acids



Gluten is difficult to digest

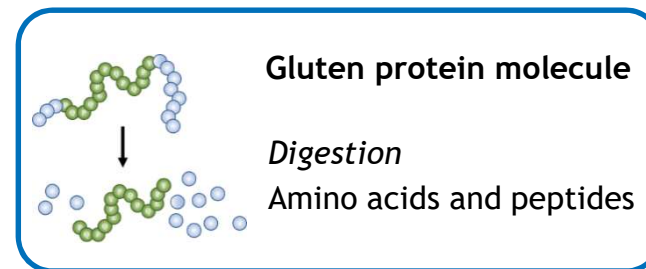
Normal protein

- After eating proteins, digestive enzymes, proteases, cut between the amino acids
- Different proteases are needed to digest proteins
- Single amino acids can be absorbed by the gut



Gluten

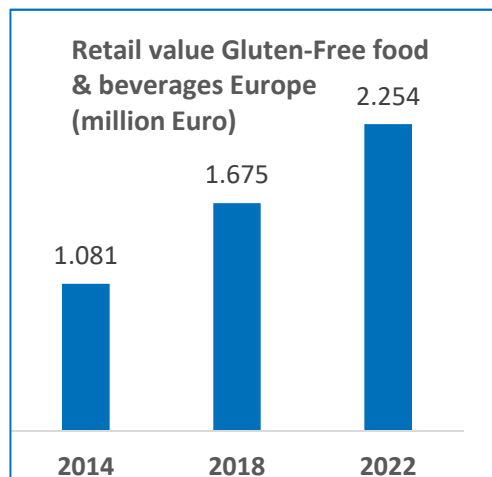
- Many Proline amino acids
- Humans don't have the enzymes that can hydrolyze at Proline
- Undigested Proline-rich peptides can cause an adverse response by the body



In vitro gluten degraded oat drink

In vitro gluten degraded oat drinks with Delvo®Plant PSP for gluten intolerant people

- Oats can contain gluten from wheat, rye and barley
- Gluten-free foods must contain < 20 ppm gluten
- Delvo®Plant PSP breaks down gluten

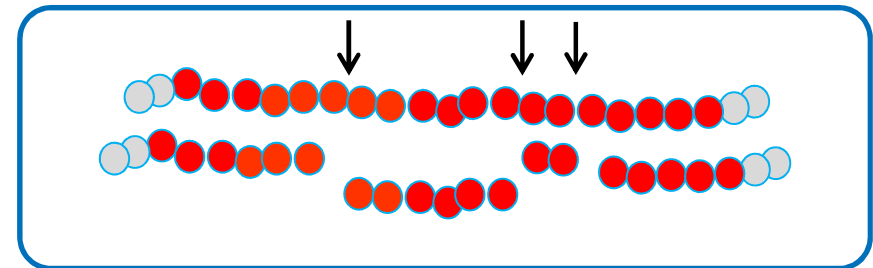
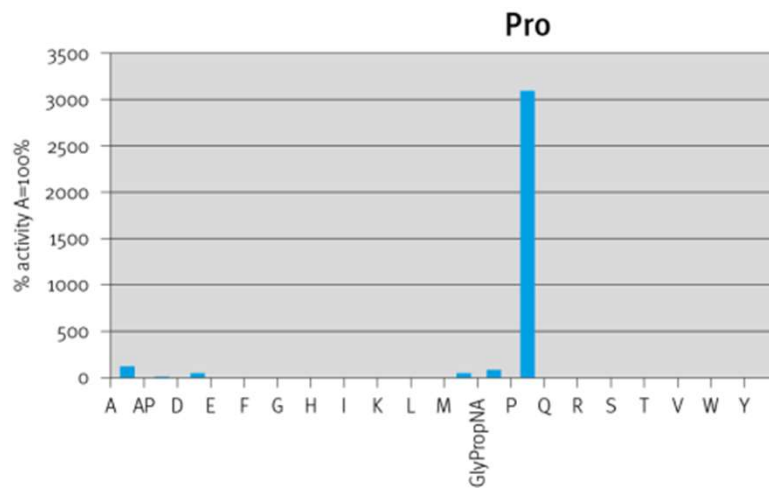


Page 18

Pure oats and pure oatmeal do not contain gluten. However, most oatmeal brands on the market today are not pure—they contain oats that have been cross-contaminated with a tiny amount of wheat, barley, and/or rye.

DSM specific enzyme solution: Proline-Specific EndoProtease (PSEP)

- Obtained from *Aspergillus niger* fungus
- Cleaves proteins/peptides in the chain, specifically after Proline
- Targeting Proline containing gluten fragments



Page 19 The graph shows the specificity of Delvo®Plant PSP, for cutting at Proline residue.
On the y axis it is shown how much (often) it cuts and on the x axis at what amino acid it likes to cut.



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