



Biodiversity in the Mediterranean Diet: Exploring the Impact of Naturally Gluten-Free Whole Grains

April 30, 2025



Learning Objectives

- Compare the nutrition composition of different gluten-free whole grains.
- Adapt a Mediterranean diet for patients with celiac-disease or who are otherwise unable to consume gluten.

Housekeeping

- Attendees will receive an email within ONE WEEK with **CPEU certificate, slides, and recording**
- Please submit any questions using the Q&A function in Zoom.
- Stay tuned for the interactive assessment

Continue Tuning in throughout the Day for more Whole Grain Academy Presentations

Noon ET

Webinar

Cooking Demo:
Whole Grains at
Breakfast, Lunch, and
Dinner



April 30
12:00 PM E.T.

2:00pm ET

Webinar

Leveraging Whole
Grains to Reduce
Healthcare Spending



April 30
2:00 PM E.T.

5:00pm ET

Webinar

Understanding Whole
Grain Food
Processing and the
Limitations of the
Nova Classification
System



April 30
5:00 PM E.T.

This webinar awards **1 CPEU** accordance with the Commission on Dietetic Registration's CPEU Prior Approval Program.

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Disclosures

I confirm that I have no relevant financial or non-financial interests to disclose.

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Biodiversity in the Mediterranean Diet:

Exploring the Impact of Naturally Gluten-Free Whole Grains

Rossella Labarbuta, Biotechnologist, PhD



The question of how to feed people and provide adequate and healthy food to eliminate hunger and malnutrition constitutes a crucial social challenge, since the world population is increasing and it is expected to rise around 9.7 billion by 2050.



This constant population growth represent a significant threat to sustainable development, as it places increasing pressure on natural resources through overexploitation, intensive farming, and land fragmentation.



Besides feeding the population, the current agro-food system is also a major driver of environmental degradation and climate change.



Additionally, food production is the largest consumer of fresh water and is responsible for up to 30% of global greenhouse gas (GHG) emissions.(1)

2 ZERO HUNGER



Despite the fact that one of the Sustainable Development Goals (SDG, Goal 2) aims to eradicate hunger by 2030, incidents of hunger and food insecurity are increasing.

Among various food sources, cereals play a crucial role in addressing hunger, as they are the main staple food worldwide and provide the majority of energy and essential nutrients for humans.

One key strategy to achieve zero hunger is to preserve the genetic diversity of the grains and develop nutrient-dense varieties with enhanced health benefits, which are also highly resistant to environmental stresses and diseases.⁽¹⁾

Grains are a key component of a healthy diet and have a longstanding tradition in the Mediterranean diet.

3 GOOD HEALTH AND WELL-BEING



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



15 LIFE ON LAND



The adoption of healthy and sustainable diets and the transition to sustainable food systems is of principal importance in order to counteract the double burden of climate change and noncommunicable diseases.

The Mediterranean diet (MD) has been widely recognized as a biodiversity and healthy nutrition resource to support sustainable development and food security.

2 ZERO HUNGER



13 CLIMATE ACTION



The Mediterranean Diet is UNESCO Intangible Cultural Heritage

- The concept of the Mediterranean Diet (MedDiet) was first introduced by the Seven Countries Study, conducted by Keys et al. in the 50s of the past century.⁽¹⁾
- The Seven Countries Study described the usual eating habits of population in Greece and Southern Italy when the globalization had not yet arrived.
- Keys observed that population in the Mediterranean countries had an exceptional longevity with some of the lowest rates of coronary heart disease and cancer vs. Western countries.
- This ecological investigation provided the foundations for the hypothesis that diet may have health protective effects.⁽²⁾
- Over the past several decades the study has advanced and today the Mediterranean Diet represents a true lifestyle.⁽³⁾

1. Mediterranean diet and public health: personal reflections. Keys, A. Am. J. Clin. Nutr. 1995; 61 (6 Suppl), 1321S–1323S

2. Mediterranean diet in the management and prevention of obesity. Dominguez LJ et al. Exp Gerontol. 2023 ;174:112121

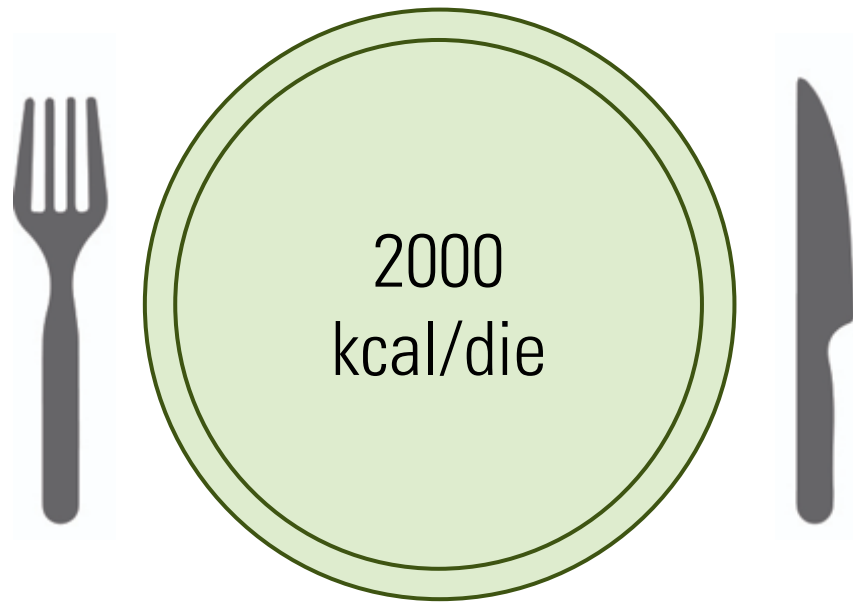
3. Definition of the Mediterranean Diet; a Literature Review. Davis C et al. Nutrients. 2015; 5;7(11):9139-53.

Recommended number of servings/daily

- Vegetables: 3–9 servings
- Fruit: 0.5–2 servings
- Cereals: 1–13 servings
- Olive oil: up to 8 servings



The MedDiet reflects the current recommendations for the dietary intake of essential macronutrient for health and wellbeing

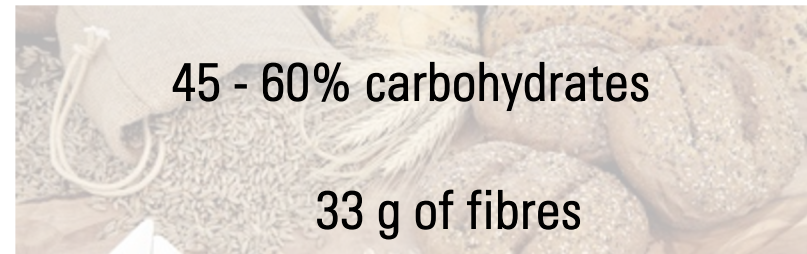


20 - 35% fat

10 - 12% protein

45 - 60% carbohydrates

33 g of fibres



«Make Half of your Grains Whole Grains»

- Chronic non-communicable diseases (CVDs, obesity, T2D and cancer) are increasing rapidly worldwide.
- Whole grains have numerous beneficial impacts on human health due to dietary fibres and phenolic compounds, which have been found to be associated with a reduced risk of chronic non-communicable diseases.
- Many whole grains are naturally gluten-free and provide beneficial nutrients as the mostly common whole grains.
- The rising global demand for nutritious, sustainable, and plant-based diet has catalyzed interest in naturally gluten-free whole grains and pseudocereals, offering an innovative alternative to traditional cereals.
- Naturally gluten-free whole grains are an alternative not only rich in nutrients but also offer environmental benefits, as many of them require less water, fewer pesticides, and can be grown in diverse climates.
- Naturally gluten-free whole grains are a great opportunity to expand the biodiversity of the Mediterranean diet at the table.

The purpose of this presentation is to deep dive the pivotal role of naturally gluten-free Whole Grains in the Biodiversity of Mediterranean diet highlighting scientific findings about their nutritional properties and health benefits.

“whole grain shall consist of intact, ground, cracked or flaked caryopsis (kernel), whose principle anatomical components including starchy endosperm, germ and bran are distributed in the same relative proportions as they exist in the intact caryopsis.” (The American Association of Cereals Chemist International, 1999)

Since 2006 the definition of whole grains includes pseudocereals because their overall macronutrient composition is comparable to that of cereals and they are used in the same traditional way as cereals.

Gluten Free Whole Grains: how can add Variety to Your Healthy Diet?



Health beneficial constituents of Whole Grains

The overall healthy benefit derived from three major components of Whole Grains (germ, bran, and endosperm).

WGs contain high amounts of phytochemicals, which are plant secondary metabolites that have shown biological activity and have been broadly investigated as health beneficial groups of compounds in food.⁽¹⁾

The major sources of these phytochemicals are phenolic compounds (PCs) due to the high concentrations of bioactive constituents in the bran and germ layer.

Vitamin E-related compounds

Phenolic compounds

Inulin

Beta-glucan

Tocols

Lignans

Phytosterols

Carotenoids

Brown Rice and Polyphenols

- Rice is one of the world's most important cereals, providing the main food for more than 50% of the world's population.
- Rice is a naturally gluten-free grain and it holds considerable importance in human nutrition, it is appreciated for its mildness, hypoallergenic properties, and easy digestibility.
- Rice is classified into brown and white rice depending on the degree of milling. ⁽¹⁾ The health benefits of whole grain rice derive mainly from one of its polyphenols, which are predominantly present in the bran layer. ⁽²⁾
- According to the husked grain color, whole grain rice varieties can be subdivided into non-pigmented rice varieties (BR varieties) and pigmented rice varieties (purple, black, and red rice varieties).⁽³⁾
- Consumption of brown rice is more beneficial than that of milled rice due to its nutritional superiority.

1. Rice-Based Gluten-Free Foods and Technologies: A Review. Jiyoung Park and Hong-Sik Kim. *Foods* 2023; 13;12(22):4110

2. Overview of the Composition of Whole Grains' Phenolic Acids and Dietary Fibre and Their Effect on Chronic Non-Communicable Diseases. Jabir Khan et al. *Int J Environ Res Public Health* 2022; 5;19(5):3042

3. Phytochemical profiles and antioxidant activity of brown rice varieties. Er Sheng Gong et al. *Food Chem.* 2017; 15:227:432-443



Brown Rice and Polyphenols

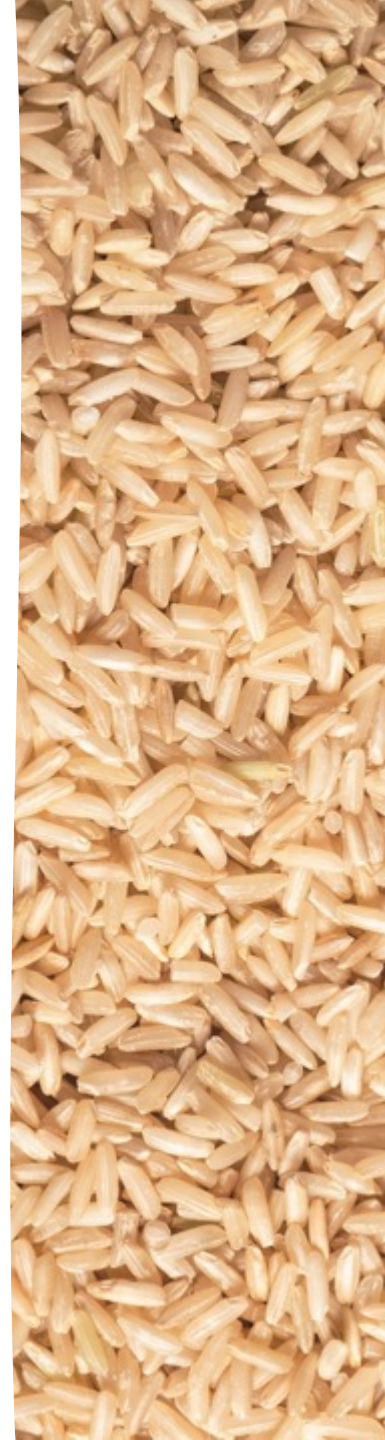
Brown rice is a rice seed from which only the husk is dehulled, and it consists of the endosperm (92%), bran (5–6%) and germ (2–3%).

Rice is often consumed as white rice, although the excessively refined milling processes of the production of white rice result in a large amount of food waste and nutrient loss.

Studies have shown that rice bran is rich in bio-functional components which are beneficial for human health, including lipids, proteins, vitamins, fibers, polyphenols, etc. ⁽¹⁾

The regular consumption of brown rice products is associated with reduced risks of chronic diseases such as type II diabetes, cardiovascular disease and obesity.

The unique phytochemicals and dietary fiber that exist in rice bran contribute to these beneficial effects.



Oat: unique among the cereals

Oat (*Avena sativa*) is a cereal grain from the Poaceae family cultivated for cattle feed (70%) and human consumption (30%). *Avena sativa* is the world's most widely grown and popular oat cultivar today.

Oat owes its fame to its unique nutritional characteristics that set it apart from other cereals:

- high protein content (ranging from 13 to 20%) and an ample amount of essential amino acids. Oat proteins are high in albumins and globulins and low in prolamins. Prolamins have a lower lysine content than albumins and globulins, and hence oat protein has a higher biological value than other cereals and the Limited Amino acid (LAA) score of oat flour is 66.9, whereas wheat flour's is 49.8.
- higher fat content (6–10%) than wheat and most other cereals (2-3%), with a high percentage of unsaturated fats.
- high concentration of antioxidant compounds. Avenanthramides, which are unique to oats, are powerful antioxidants with high antioxidative activity in humans.



Beta-glucan: more than a fiber.....

- good source of soluble dietary fiber, particularly β -glucan, a powerful bioactive compound, extremely important in human nutrition.

β -Glucan has been shown to lower blood cholesterol and glucose absorption in the intestine, thereby preventing diseases such as cardiovascular injury, dyslipidemia, hypertension, inflammatory state, and type 2 diabetes.

The European Food and Safety Authority and the US Food and Drug Administration (FDA) have accredited health claims for oat foods containing oat β -glucan to lower serum cholesterol and the risk of CVD.

The recommended intake for a cholesterol-lowering effect is 3 g of oat β -glucan per day.

Oat-based food products are gaining popularity as functional foods, provide a natural way to enhance overall wellness



Teff: the ancient cereal of Ethiopian tradition

Teff (*Eragrostis tef*) is native of Ethiopia and Eritrea where it is consumed mainly in the form of injera.⁽¹⁾

Teff grain is hull-less (naked) and comes in a range of colors from milky-white to almost dark brown. The most common colors are white, creamy-white, light brown, and dark brown.

The word teff derives from the word *teffa* which means “lost” due to small size of the grain (less than 1 mm in diameter) and how easily it is lost if dropped.

Teff is becoming globally popular due to the attractive nutritional profile.

Teff has been implicated in the low incidence of anaemia in Ethiopia and it is presumed to be due to the grain’s high content of iron. In addition, according to the same studies, malaria is frequently found in the groups with lower haemoglobin levels.⁽²⁾

1. Mediterranean Gluten-Free Diet: Is It a Fair Bet for the Treatment of Gluten-Related Disorders? Karla A. et al. *Frontiers in Nutrition* 2020; 2:7:583981

2. Teff (*Eragrostis tef*) as a raw material for malting, brewing and manufacturing of gluten-free foods and beverages: a review. Mekonnen Melaku Gebremariam et al. *J Food Sci Technol* 2012; 51(11):2881-95



Teff is highly nutritious

PROTEIN

Protein content is 11%.

High amount of the essential amino acids (lysine content 3.68 g/100 g).
Easy to digest because the main protein fractions such as albumin, glutelin, and globulin are the most digestible types.

FIBER

Fiber content is 3%.

MICRONUTRIENT

Rich in minerals such as calcium, zinc, magnesium, iron, phosphorous.
Contains good level of vitamins (C, A, niacin, riboflavin, and thiamine).
A source of bioactive compounds such as polyphenols.

Culinary Uses:

Injera: The most iconic use of teff is in *injera*, a spongy, slightly sour flatbread that serves as both a plate and a utensil in Ethiopian meals.

Flour: Teff flour can be used to make bread, pancakes, porridge, and baked goods. It's often mixed with other gluten-free flours in baking.

Grain: You can cook whole teff grains similarly to rice or quinoa, and it's often used as a side dish or in soups and stews.



Sorghum: an ancient grain for a sustainable food system

Sorghum is a drought-tolerant cereal and it is the world's fifth most important cereal after wheat, rice, maize and barley.

The United States is the most significant producer of this crop, followed by Nigeria, Ethiopia, India, Mexico and China.

Sorghum has small seeds with pigmented pericarp, and the most commercially available varieties are black, white and red. White sorghum is used for food products, while red sorghum is utilized primarily in the alcohol distillation industry. Sorghum grains are ovoid with one end more pointed.

Sorghum varieties are classified into five groups based on their end-use applications: sweet sorghum (for syrup and biofuel), grain (for biofuel, human food, and animal feed), fiber, forage/fodder (for animal feed), and broomcorn (for broom-making)⁽¹⁾



Sorghum: an ancient grain for a sustainable food system

Starch is the main component of sorghum (about 70%); however, sorghum grains show the highest content of resistant starch (4–21%) and lowest starch digestibility (~19–37% rapidly digestible starch) and glycemic index among cereal crops.

The major protein fractions in sorghum are prolamins (kafirins), followed by glutelins; however, it has a low content of essential amino acids.

The lipid in sorghum grains is made up of saturated fats and a high concentration of unsaturated fatty acids.

Sorghum, especially red sorghum, contains various phytochemicals, mainly phenolic acid (mostly ferulic acid), flavonoids and tannins, with substantial health-promoting effects.

Some sorghum grains, especially pigmented grains, have limited applications as human foods due to the presence of condensed tannins contributing to bitter taste



Buckwheat as functional food

Buckwheat (*Fagopyrum* sp.) is a promising environmentally friendly crop that can contribute to the balance between biodiversity benefits and crop yield.

Buckwheat is native to south-central China and has been introduced into suitable climates across Europe, Africa and the Americas.

Despite its name, buckwheat is not a cereal, nor is it even a member of the grass family, but its chemical composition allows them to be used in cooking like a cereal.

The growing popularity of buckwheat is largely due to its attractive nutritional quality.⁽¹⁾

Buckwheat has been reported to possess bioactive components (such as rutin and quercetin) known for their anti-inflammatory and antioxidant properties.⁽²⁾

1. Buckwheat: an underutilized crop with attractive sensory qualities and health benefits. Galia Zamaratskaia et al. *Critical Reviews in Food Science and Nutrition*. 2024, 64(33):12303-12318

2. Gluten-Free Cereal Products and Beverages: A Review of Their Health Benefits in the Last Five Years Muhammad Arif Najmi Khairuddin et al. *Foods* 2021, 21;10(11):2523



Bioactive Compounds in Buckwheat

PROTEIN

Protein content is 5.7–14.2%

Exceptional balance of amino acids, with higher content of lysine, methionine and cysteine than common cereals.

FIBER

Excellent source of dietary fiber (up to 17%), composed by 6.8% of lignin, 2.2% of hemicellulose and 10.6% of cellulose

LIPID

Lipid content 0.75–7.4% mostly represented by unsaturated fatty acid 80.1–80.9% of total lipids.

MICRONUTRIENT

Higher amount of Magnesium, Potassium, Phosphorous and a source of phenolic compounds (rutin and quercetin)



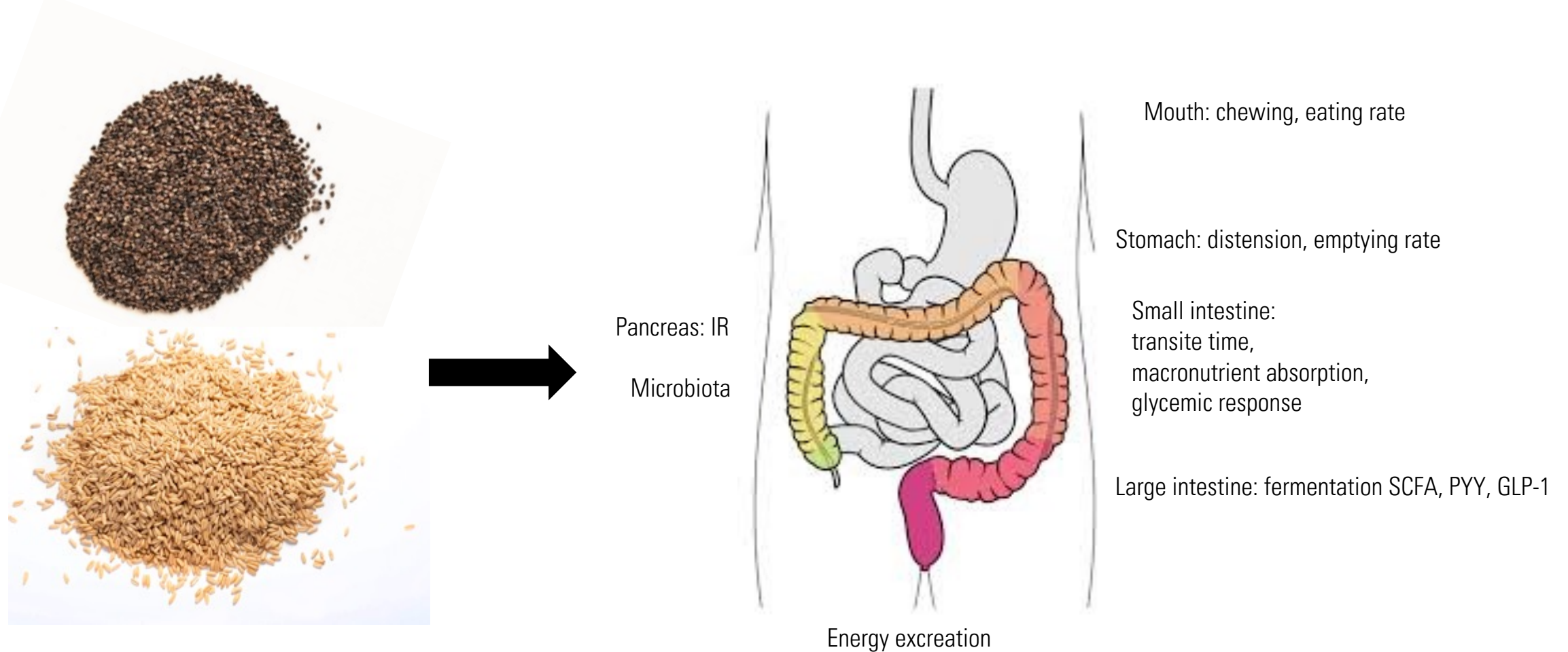
Whole Grains and Health: an overview of potential protective effects

Mediterranean diet and other obesity-related chronic diseases

Although the mechanisms underlying the beneficial effects of the Mediterranean Diet are not yet fully understood, several molecular and clinical mechanisms have been studied to help explain the positive impact of this dietary pattern.

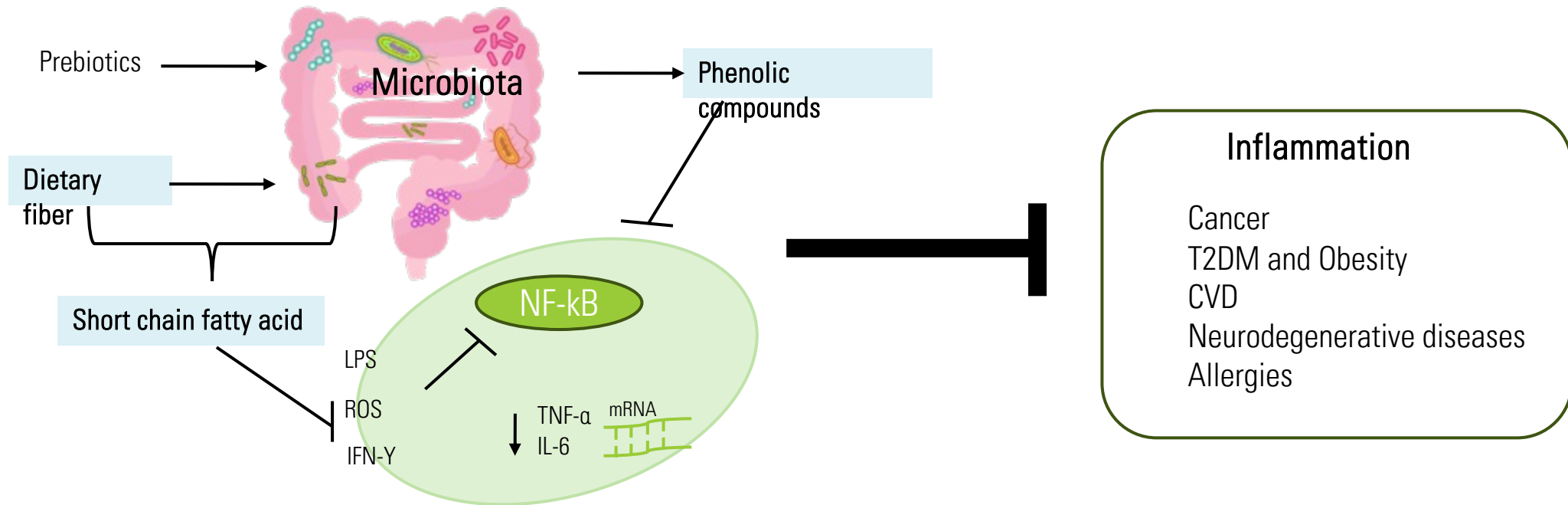


Correlations between the consumption of whole grains and body weight management: the role of gut microbiota



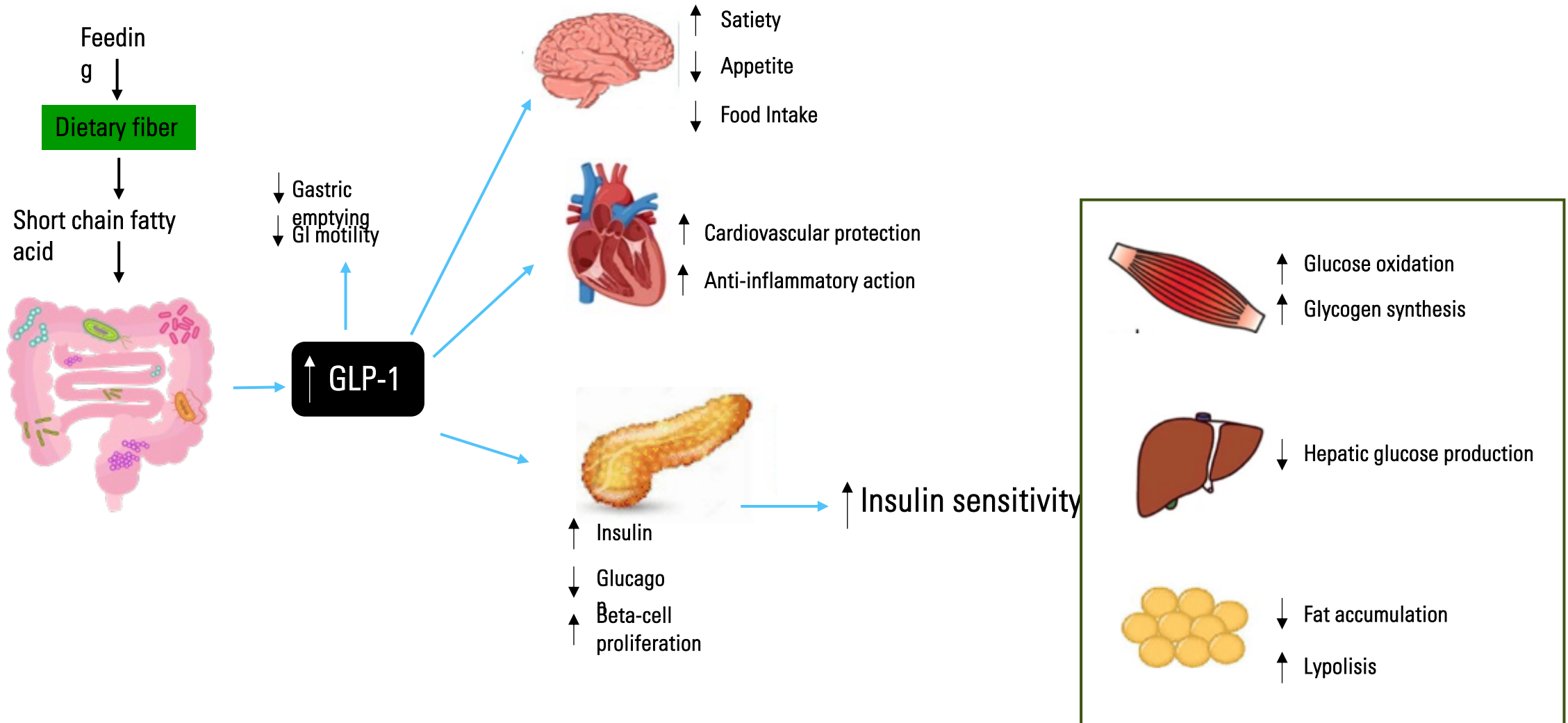
IR: insulin response; GLP-1: glucagon-like peptide-1; PYY: peptide; SCFA: short-chain fatty acid

Connections between whole grain dietary fiber and phenolic compounds and inflammation: what is the evidence?

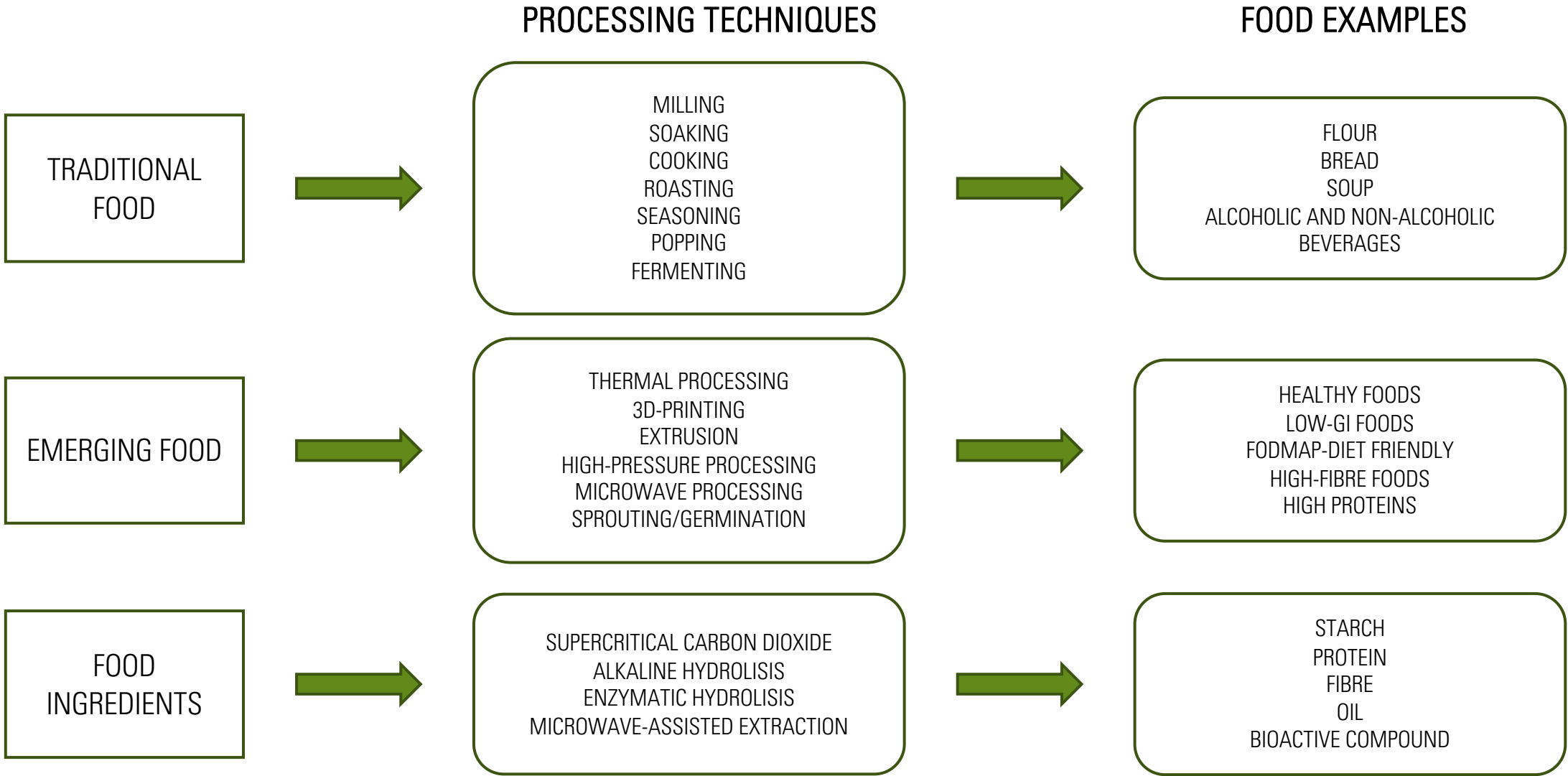


interferon gamma (IFN- γ), interleukin 1 beta (IL-1 β), interleukin 6 (IL-6), inducible nitric oxide synthase (iNOS), lipopolysaccharide (LPS), reactive oxygen species (ROS), and tumor necrosis factor alpha (TNF- α)

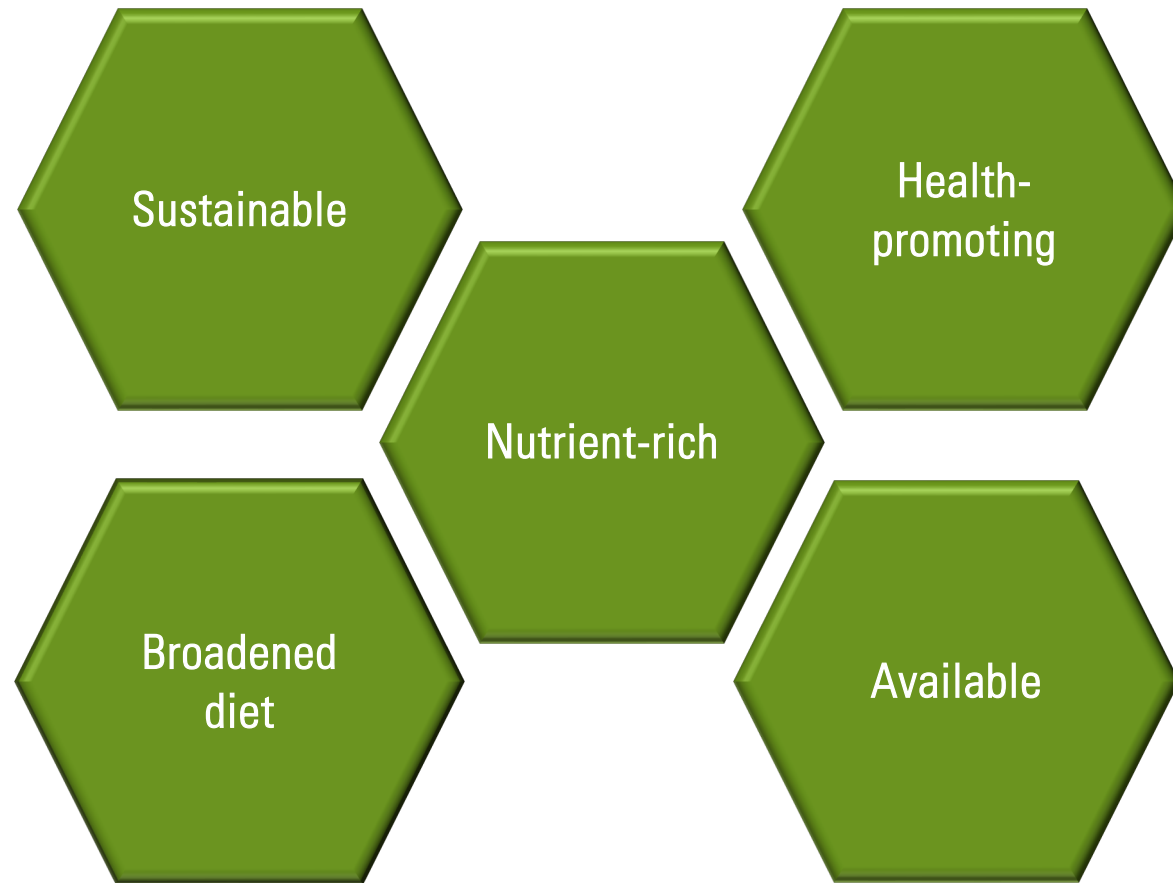
Whole grain intake and GLP-1: the role of gut microbiota



Current food applications



Why naturally gluten-free whole grains in Mediterranean Diet?



OPPORTUNITIES AND CHALLENGES

Naturally gluten-free whole grains should be considered an added value in the biodiversity of Mediterranean diet.

The use of these whole grains in food industry can improve world food security and economic growth.

Future research should be focused on:

- breeding programs toward cultivars with improved agronomic characteristics and superior nutritional qualities
- developing technological processes able to produce innovative foods, preserve nutrients and bioactives, and meet consumer expectations.

OPPORTUNITIES AND CHALLENGES

A key challenge for the food industry is to increase the whole grain content in processed foods without compromising taste and texture.

To improve population diet quality, public health professionals can help patients understand the research on whole grains and health benefits, and how people with different dietary needs can meet recommended whole grain intake.

THANK YOU

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Interactive Assessment

POLL: Which of these gluten-free grains has the highest content of resistant starch?

- A. Oats
- B. Brown rice
- C. Teff
- D. Sorghum
- E. Buckwheat

POLL: Which of these gluten-free grains has the most balanced amino acid profile, which a higher content of lysine, methionine, and cysteine than most other grains?

- A. Oats
- B. Brown rice
- C. Teff
- D. Sorghum
- E. Buckwheat

Reflection Question:

How can you adapt a Mediterranean diet for patients with celiac-disease or who are otherwise unable to consume gluten?