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OBTAINING LOW-GLYCEMIC-INDEX FOODS USING DIETARY FIBER AND RESISTANT STARCH

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Abstract:

Developing foods with a low glycemic index is an important area of food science. This review examines the role of dietary fibers and resistant starch in obtaining such foods, with emphasis on their sources, functional properties and applications in food processing, and on how technological treatments such as cooking and cooling affect starch digestibility and the formation of resistant starch. Their incorporation into bread, cereal-based products and other starch-rich foods may improve nutritional profile, but possible changes in texture, taste and quality must be taken into account. Dietary fibers and resistant starch are promising ingredients for balancing glycemic response, product quality and consumer acceptability.

Introduction:

Foods rich in rapidly digestible starch can lead to pronounced postprandial glycemic responses. The development of foods with a low glycemic index (GI) is therefore an important research area in food science, aimed at improving the nutritional quality of carbohydrate-rich products such as bread and other cereal-based foods. Dietary fibers and resistant starch (RS) have attracted attention because of their potential to influence starch digestion. This review summarizes their sources, functional properties and applications in food processing.

- Dietary fibers (soluble and insoluble) are found in cereals, legumes, fruits and vegetables; their effect depends on their physicochemical properties and on the composition of the food matrix.
- Resistant starch, unlike digestible starch, is not fully broken down in the small intestine and can reach the colon, where it may be fermented by the intestinal microbiota.
- Processing methods, such as cooking and cooling, can affect starch digestibility and the formation of resistant starch.
- Quality: adding these components may change texture, taste and other characteristics that influence consumer acceptance.
- The food processing steps involved in obtaining low-glycemic-index foods using dietary fiber and resistant starch are illustrated in Figure 1.

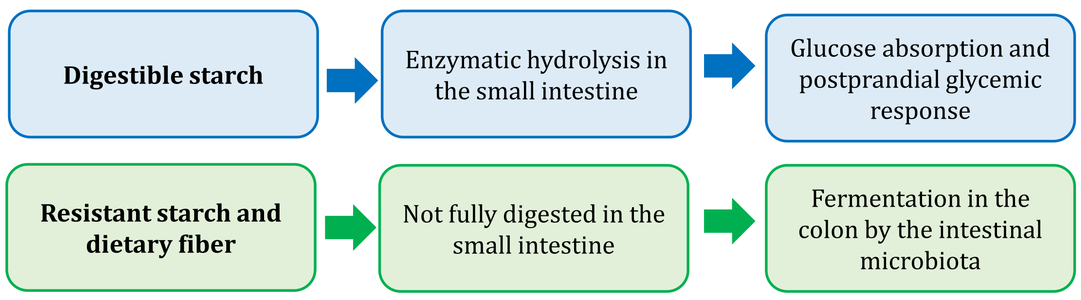


Figure 1. *Digestible starch versus resistant starch and dietary fiber: fate in the digestive tract.*

Materials and Methods:

This review is based on an analysis of scientific literature relevant to the development of low-glycemic-index foods using dietary fiber and resistant starch. Published studies were examined to identify the main approaches, findings, and developments reported in the field, including the sources and functional properties of these ingredients and their applications in food processing. Particular attention was given to the methodologies applied, the results obtained, and the factors influencing their interpretation, such as ingredient properties, food matrix composition and processing conditions. The available information was compared and critically evaluated to highlight similarities, differences, and potential limitations among the studies. The findings were subsequently organized into thematic sections, supported by comparative tables and figures where appropriate, to provide a clear overview of the current state of knowledge and identify areas requiring further investigation.

Results and Discussions:

Sources and functional properties. Soluble and insoluble fibers and the different types of resistant starch (Table 1) occur in cereals, legumes, tubers and fruits; their effect on starch digestion depends on their physicochemical properties and on the composition of the food matrix.

Table 1. *Comparison of dietary fibers and resistant starch types relevant for low-GI foods.*

Ingredient	Typical sources	Main role in starch digestion	Technological considerations	Reference
Soluble dietary fiber	Oats, barley (β-glucan), fruits (pectin), legumes	Increases viscosity of digesta; may slow starch digestion	May change dough rheology and texture	Dikeman & Fahey, 2006
Insoluble dietary fiber	Cereal bran, whole grains, vegetables	Adds bulk and dilutes digestible starch	Darker color, coarser texture, higher water absorption	Sempio et al, 2024
RS1 – physically inaccessible	Whole or partly milled grains, seeds, legumes	Starch enclosed in cell structures, limiting enzyme access	Reduced by fine milling and extensive processing	Walsh et al, 2022
RS2 – native granules	Raw potato, green banana, high-amylose maize	Granule structure resists enzymatic hydrolysis	Largely lost on gelatinization (cooking)	Raigond et al, 2015
RS3 – retrograded starch	Cooked and cooled bread, potato, rice, pasta	Formed by retrogradation of gelatinized starch	Depends on cooking, cooling and storage conditions	Walsh et al, 2022 Raigond et al, 2015

Technological treatments. Cooking gelatinizes starch and increases its digestibility, whereas cooling and storage promote retrogradation and the formation of resistant starch (Figure 2).

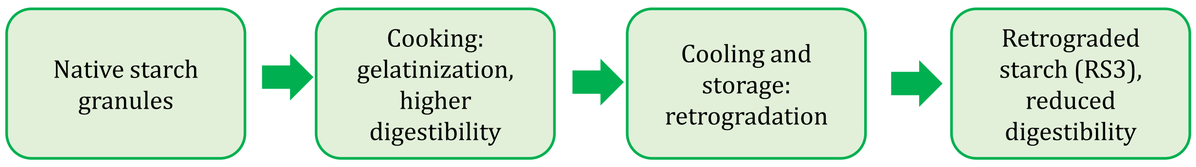


Figure 2. *Effect of cooking and cooling on starch digestibility.*

Processing can therefore change the glycemic potential of the same raw material.

Food applications. Incorporating fibers and RS into bread, cereal-based products and other starch-rich foods may improve their nutritional profile and supports the development of low-GI foods.

Quality and acceptance. Higher fiber or RS levels may alter texture, taste and other quality traits, so formulations must balance glycemic response, product quality and consumer acceptability.

Conclusions:

- Dietary fibers and resistant starch are promising ingredients for foods with improved nutritional properties, offering opportunities to balance glycemic response, product quality and consumer acceptability.
- Technological treatments, such as cooking and cooling, influence starch digestibility and RS formation, so process design is as important as ingredient choice.
- Further research is needed to optimize formulations and processing conditions that combine glycemic benefits with the texture, taste and quality expected by consumers.