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Final degree project
January 2023

Bibliographic Review – The Technological Application of Resistant Starch and its Health Benefits on the Formulation of Pasta in the Food Industry.

INTRODUCTION

- Dietary **fiber** has been identified as a **nutrient of public health concern** (2).
- **22% of the Spanish population is obese** (3). Excess body weight is associated with an increased risk of developing certain diseases (4).
- **Pasta**, a food with a high consumption, is reduced by overweight people because it is **perceived as an unhealthy food** (5).

STARCH is the main source of carbohydrate in the human diet, and the most abundant storage polysaccharide in plants (1).

RESISTANT STARCH (RS): Englyst et al. (1982) first described RS, as the **starch fraction able to pass through the small intestine intact and then it ferments in the large intestine, producing short chain fatty acids**. It can be considered as a dietary fiber. It is capable of giving technological characteristics to food and beneficial health effects (1, 7-9).

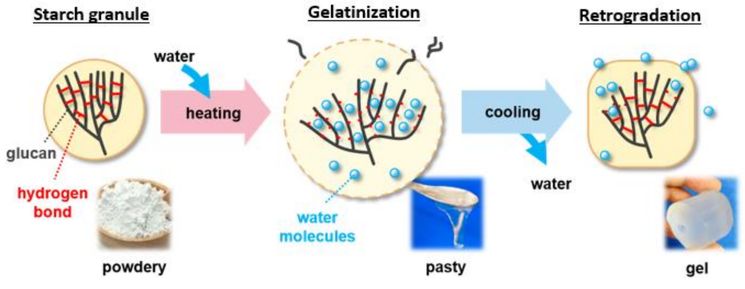

Figure 1: Starch granule structure (6)

OBJECTIVES

1. Identify the relationship between the structure and composition of resistant starch granules with their digestibility and the health benefits they provide.
2. Learn about the application of RS and how it affects the technological properties of pasta.

METHODOLOGY

Bibliographic review prepared with the collection of information from various databases as: PubMed, the UAB library and Google Academic. The sources used are: articles (studies, systematic review, met analyses), official websites and books.

RESULTS

- RS is present in grain products, seeds, legumes, tubers, green fruits and in commercially purified forms. It **provides ~ 2 kcal/g** (1).
- There are **five different types of RS**: RS 1, RS 2, RS 3, RS 4 and RS 5 (1).
- Starch resistance depends on: granule size, amylase – amylopectin ratio, crystallinity and granule surface (1).

Table 1: RS properties (1,2,9,10)

Health benefits	Technological properties	Addition methods
EFSA, 2011: • ⬇ Glycemic response Potential evidence: • Satiety regulation • Prebiotic effect • Preservation of normal blood lipid profile • Microbiota composition	Characteristics: • Natural sources • White color • Mild flavor • Large particle size Technological properties • Increase viscosity • Gel forming capacity • Water holding capacity • Improves texture • Tolerates high temp. • Resistant & smooth films	Different treatments: • Enzymatic • Chemical • Physical

Table 2: Collection of studies about the enrichment of pasta with different sources of RS (11 – 18)

Fibers	RS/100 g Cooked Pasta	Comments
RS 2 RS 3	-	Suitable fibers to replace wheat starch. Did not affect negatively organoleptic properties.
RS 2 RS 3	9.82 11.85	Best characteristics in pasta were found with 20% of RS.
RS 2 RS 4 OB	11.2% (TDF) 12.2% (TDF) 14.3% (TDF)	RS 2, RS 4: They were considered acceptable. OB showed positive effects with additions up to 5%.
RS2 RS4 OB	11.3 ± 0.2 6.4 ± 0.0 2.9 ± 0.2	RS 2 showed the best acceptability.
RSF WSF	36.96 ± 0.48 36.27 ± 0.23	Addition of 20% were considered acceptable.
BF	-	Increase nutritional value (protein and RS).
BF	13.54 ± 0.93	The more flour added, the more RS was produced.
SPS	2.46 ± 0.05	Additions greater than 30% were not favorable.

(OB: Oat bran); (TDF: Total dietary fiber); (RSF: red sorghum flour); (WSF: white sorghum flour); (BF: Bean flour); (SPS: Sweet potato starch).

CONCLUSIONS

- ✓ **Starch structure** is related with **functionality** and **digestibility**.
- ✓ RS 2, RS 3, RS 4: it has positive results in additions up to 20%.
- ✓ OB: it has a favorable outcome in additions up to 5%.
- ✓ SF: it has a favorable outcome in additions up to 20%.
- ✓ BF: it is a good alternative because it is a source of RS and protein.
- ✓ SPS: it is favorable in additions lower than 30%.
- ✓ **Lots of sources of RS can be used** to increase the content of RS, to improve nutritional value and to decrease digestibility in pasta formulations.
- ✓ The **best acceptance** among consumers is the enriched pasta with **RS2**.
- ✓ Acceptance and formulation depends on the **type** and **amount of fiber added**.
- ✓ **Heterogeneous results** have been found in **organoleptic properties**.
- ✓ **In Europe enriched products with RS are limited**. So, according to the promising results of the analyzed studies, the formulation of pasta enriched with RS could be a **significant market opportunity** for the food industry.

FUTURE RESEARCH

- Lack of a universally unification of quantity and quality quantification techniques of RS.
- Lack of a universally accepted assessment of the energetic power of RS.
- It is necessary more studies with a large sample of population and long-term follow-up protocols to study more depth the health benefits of RS and the acceptance of RS enriched products.

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