# Introduction

1. Food microstructure and digestion
   2. Carbohydrate digestion
      2.1. Carbohydrates and diabetes
      2.2. In vivo and in vitro digestion studies
   2.3. Starch
      2.3.1. Structure
      2.3.2. Starch digestion

3. Strategies to modulate starch digestion
   3.1. Effect of starch characteristics on its digestion
   3.2. Inhibition of starch digestive enzymes
      3.2.1. Dietary fibers
      3.2.2. Acidic ingredients
      3.2.3. Polyphenols

4. Starch and polyphenol interaction

# Objectives

# Results

Mastication of crisp bread: role of bread texture and structure on texture perception

1.1. Introduction

1.2. Materials and methods
   1.2.1. Bread samples and characterization
   1.2.2. FOP assessment
   1.2.3. Characterization of bolus properties
1.2.4. Sensory assessment
1.2.5. Statistical data analyses
1.3. Results and discussion
1.3.1. Bread characteristics
1.3.2. Sensory evaluation
1.3.3. Characterization of FOP and bolus properties
1.3.4. Texture, FOP and sensory correlations
1.4. Conclusions

Effect of bread structure and in vitro oral processing methods in bolus disintegration and glycemic index

2.1. Introduction
2.2. Materials and methods
2.2.1. Materials
2.2.2. Bread preparation
2.2.3. Bread characterization
2.2.4. In vitro oro-gastro-intestinal digestion
2.2.5. Reducing sugars released and in vitro starch digestibility
2.2.6. Particle size distribution of the bolus during in vitro digestion
2.2.7. Statistical analyses
2.3. Results and discussion
2.3.1. Variation of bread structure as a consequence of changes in the breadmaking process
2.3.2. Bolus particle size throughout in vitro digestion
2.3.3. In vitro digestion and expected glycemic index
2.3.4. Multivariable analysis
2.4. Conclusions

In vitro digestibility of gels from different starches: relationship between kinetic parameters and microstructure

3.1. Introduction
3.2. Materials and methods
3.2.1. Materials
3.2.2. Chickpea starch isolation
3.2.3. Starch gel preparation
3.2.4. Chemical composition of starches
3.2.5. *In vitro* oro-gastro-intestinal digestion and reducing sugar analysis
3.2.6. Starch digestion modelling
3.2.7. Scanning electron microscopy (SEM)
3.2.8. Statistical analyses

3.3. Results and discussion
3.3.1. Starch gels
3.3.2. *In vitro* digestion and modelling

3.4. Conclusions

4. Understanding phenolic acids inhibition of α-amylase and α-glucosidase and influence of reaction conditions

4.1. Introduction
4.2. Materials and methods
4.2.1. Materials
4.2.2. Inhibition assays of α-amylase
4.2.3. Inhibition assays of α-glucosidase
4.2.4. Percentage of inhibition and IC$_{50}$
4.2.5. High-performance liquid chromatography analysis
4.2.6. Statistical analyses
4.2.7. Structure-activity relation

4.3. Results and discussion
4.3.1. Inhibition of α-amylase
4.3.2 Polyphenols inhibition of α-glucosidase

4.4. Conclusions

5. *In vitro* inhibition of starch digestive enzymes by ultrasound-assisted extracted polyphenols from *Ascophyllum nodosum* seaweeds

5.1. Introduction
5.2. Material and methods
5.2.1. Materials
5.2.2. Seaweed sampling
5.2.3. Chemical analysis
5.2.4. Inhibition assays of $\alpha$-amylase and $\alpha$-glucosidase
5.2.5. Chromatographic separation
5.2.6. $^1$H-NMR
5.2.7. Statistical analyses
5.3. Results and discussion
5.3.1. Seaweed extracts chemical composition
5.3.2. Inhibition effect of seaweed extracts against $\alpha$-amylase and $\alpha$-glucosidase enzymes
5.3.3. Seaweed freeze-dried extracts characterization: chromatography (RP-HPLC-UV) and nuclear magnetic resonance ($^1$H-NMR)
5.4. Conclusions

Starch gels enriched with phenolic acids: effects on structure and digestibility
6.1. Introduction
6.2. Material and methods
6.2.1. Materials
6.2.2. Starch gels preparation and pasting properties of the slurries
6.2.3. High-performance liquid chromatography analysis of phenolic acids
6.2.4. Scanning electron microscopy
6.2.5. Gel firmness
6.2.6. Hydrolysis kinetics
6.2.7. Statistical analysis
6.3. Results and discussion
6.3.1. Starch-polyphenol gels formation
6.3.2. Textural and structural characterization of starch gels
6.3.3. Digestibility of starch-polyphenol gels
6.4. Conclusions