

**PhD SCHOOL OF AGRI-FOOD SCIENCES, TECHNOLOGIES AND BIOTECHNOLOGIES
XXXV CYCLE – II YEAR**

ANNUAL WORKSHOP: 17TH DECEMBER 2021

BIOACCESSIBILITY, BIOACTIVITY AND CELL METABOLISM OF PHENOLIC COMPOUNDS FROM VEGETABLE FOODS



PHD STUDENT: DR. ALICE CATTIVELLI
NUTRITIONAL BIOCHEMISTRY LAB
alice.cattivelli@unimore.it

TUTOR: PROF. DAVIDE TAGLIAZUCCHI
PhD PROGRAM COORDINATOR: PROF. ALESSANDRO ULRICI



ALICE

WHAT SHOULD
I COOK FOR
TONIGHT?



GRILLED VEGETABLES



BOILED VEGETABLES



BAKED VEGETABLES



FRIED VEGETABLES



RAW VEGETABLES

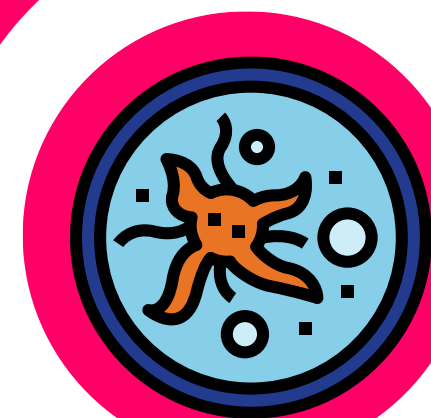
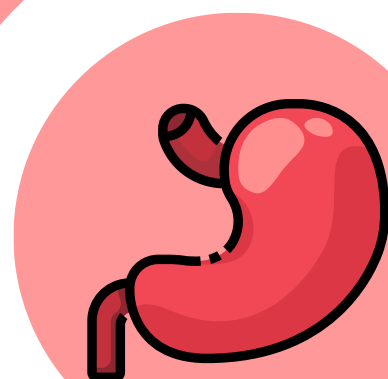


AIM OF THE PROJECT

TO INVESTIGATE THE EFFECT OF DIFFERENT HEAT TREATMENTS ON TWO VEGETABLE MATRICES RICH IN PHENOLIC COMPOUNDS

BIOACCESSIBILITY

BIOACTIVITY



STABILITY TO HEAT
THERMAL TREATMENTS

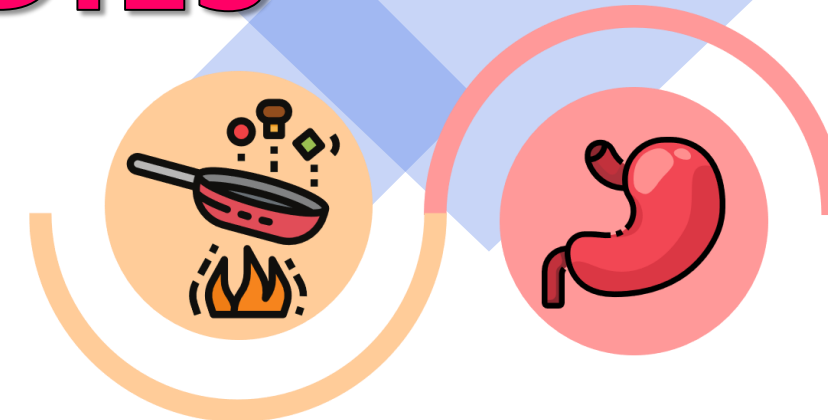
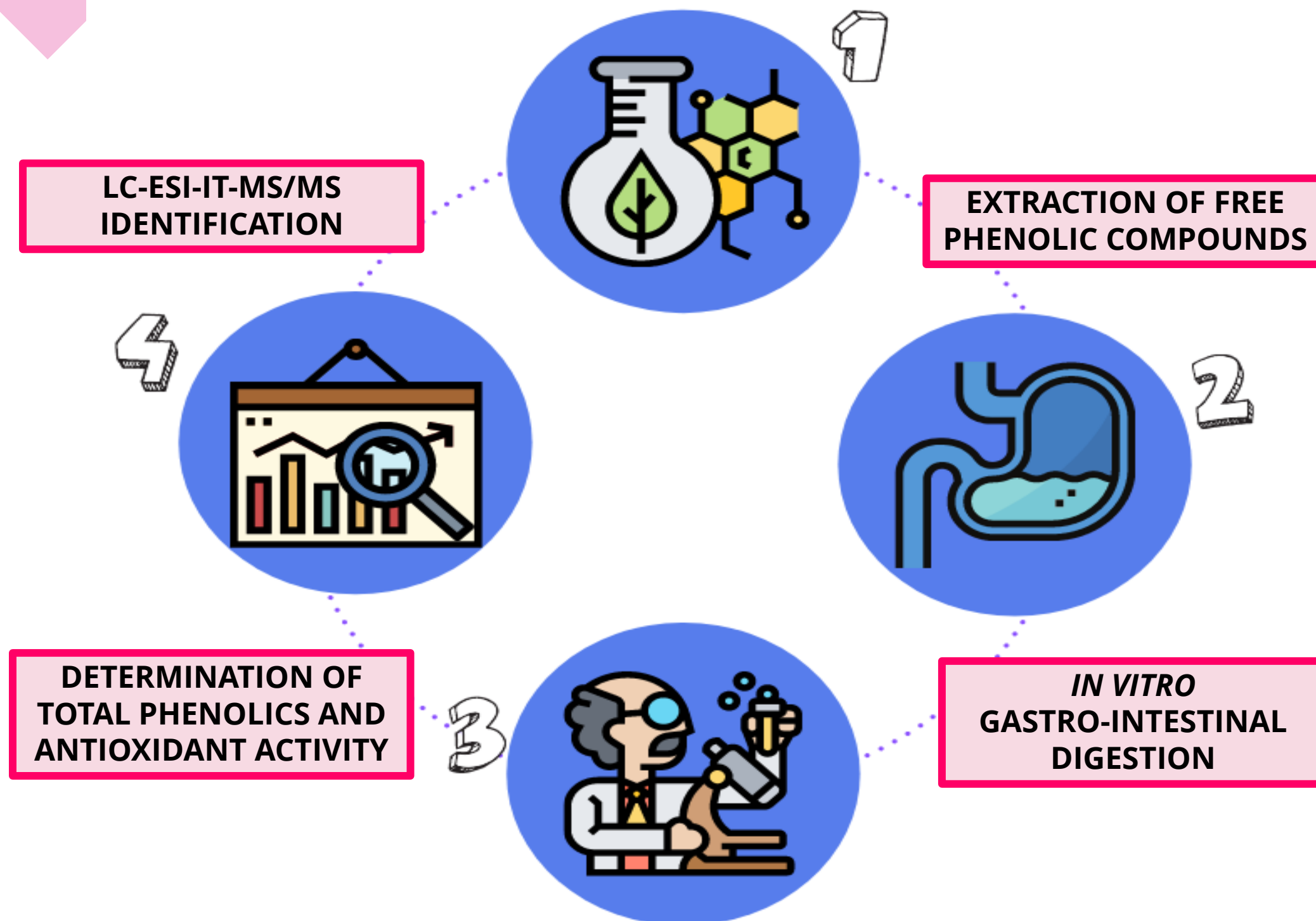
STABILITY TO *IN VITRO*
GASTRO-INTESTINAL
DIGESTION

ANTIDIABETIC
PROPERTIES

ANTIPROLIFERATIVE
ACTIVITY ON CANCER
CELLS

STUDY OF COLONIC
METABOLISM

1st YEAR – BIOACCESSIBILITY STUDIES



RESULTS



Domestic cooking methods affect the stability and bioaccessibility of dark purple eggplant (*Solanum melongena*) phenolic compounds

Serena Martini, Angela Conte, Alice Cattivelli, Davide Tagliazucchi*

Department of Life Sciences, University of Modena and Reggio Emilia, Via Amendola 2, 42100 Reggio Emilia, Italy

<https://doi.org/10.1016/j.foodchem.2020.128298>



Article

Influence of Cooking Methods on Onion Phenolic Compounds Bioaccessibility

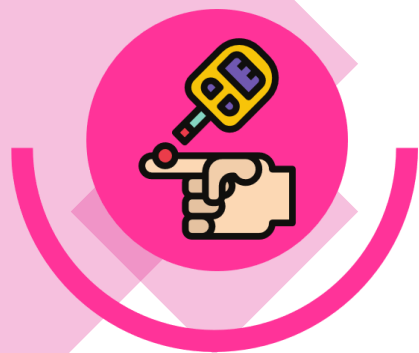
Alice Cattivelli, Angela Conte *, Serena Martini and Davide Tagliazucchi

Department of Life Sciences, University of Modena and Reggio Emilia, 42100 Reggio Emilia, Italy; alice.cattivelli@unimore.it (A.C.); serena.martini@unimore.it (S.M.); davide.tagliazucchi@unimore.it (D.T.)

* Correspondence: angela.conte@unimore.it; Tel.: +39-0522-522060



<https://doi.org/10.3390/foods10051023>



2nd YEAR – BIOACTIVITY STUDIES

ANTIDIABETIC PROPERTIES

TYPE-2 DIABETES is a metabolic disorder that in the long term leads to serious chronic diseases affecting the cardiovascular, renal, and nervous systems. This pathology is one of the leading causes of death worldwide. The management of T2D aims to **reduce blood glucose levels**.

**MORBIDITY
MORTALITY**



TREATMENTS
can be both



PHARMACOLOGICAL



NON-PHARMACOLOGICAL

- HEALTHY LIFESTYLE
- BALANCED DIET
- NATURAL ANTI-DIABETIC AGENTS
(**PHENOLIC COMPOUNDS**)

MATERIALS AND METHODS



Cooking treatments of dark purple eggplant and red-skinned onion



In vitro gastro-intestinal digestion



Preparation of the phenolic-rich fraction



Identification of phenolic compounds in phenolic-rich fractions by LC-ESI-IT-MS



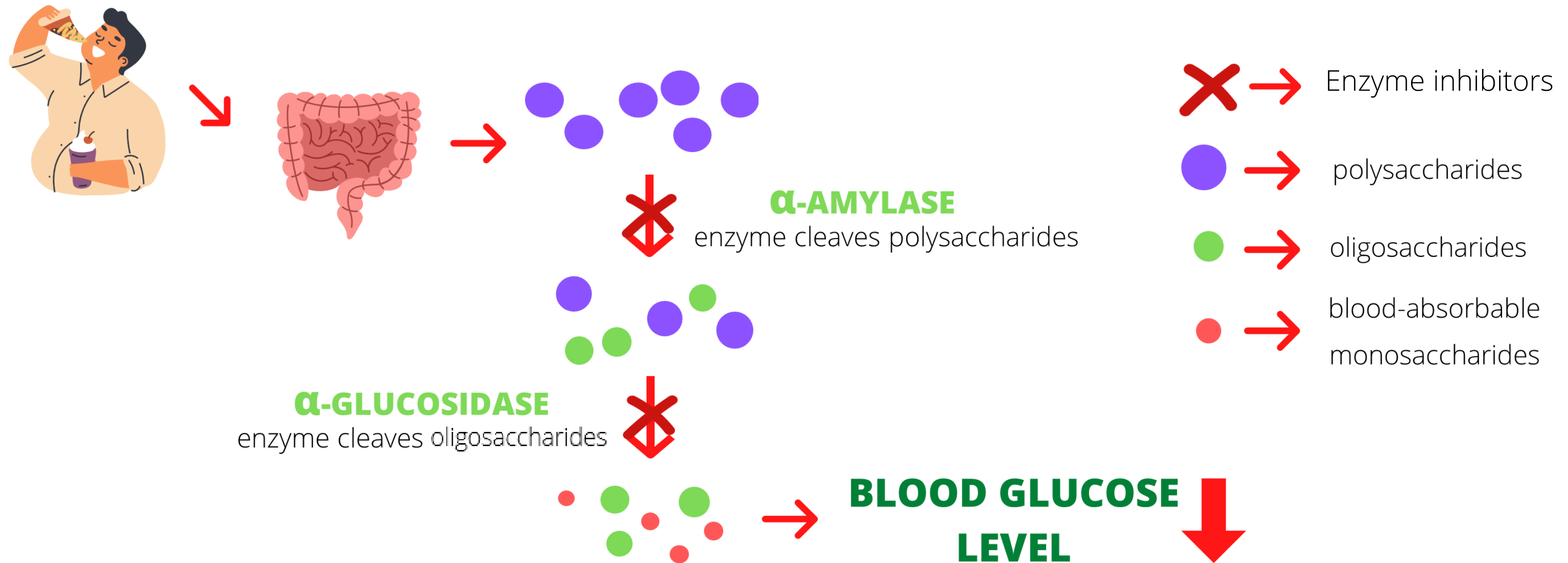
Biological activity analysis



Statistics

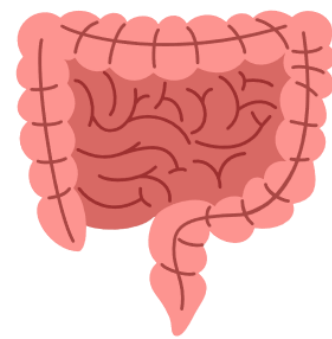
MECHANISM OF INACTIVATION

α -AMYLASE AND α -GLUCOSIDASE INHIBITORS



MECHANISM OF INACTIVATION

DPP-IV INHIBITORS



DPP-IV

enzyme inactivates GLP-1



GLP-1



Stimulates insulin secretion



Supresses glucagon secretion



→ Enzyme inhibitors

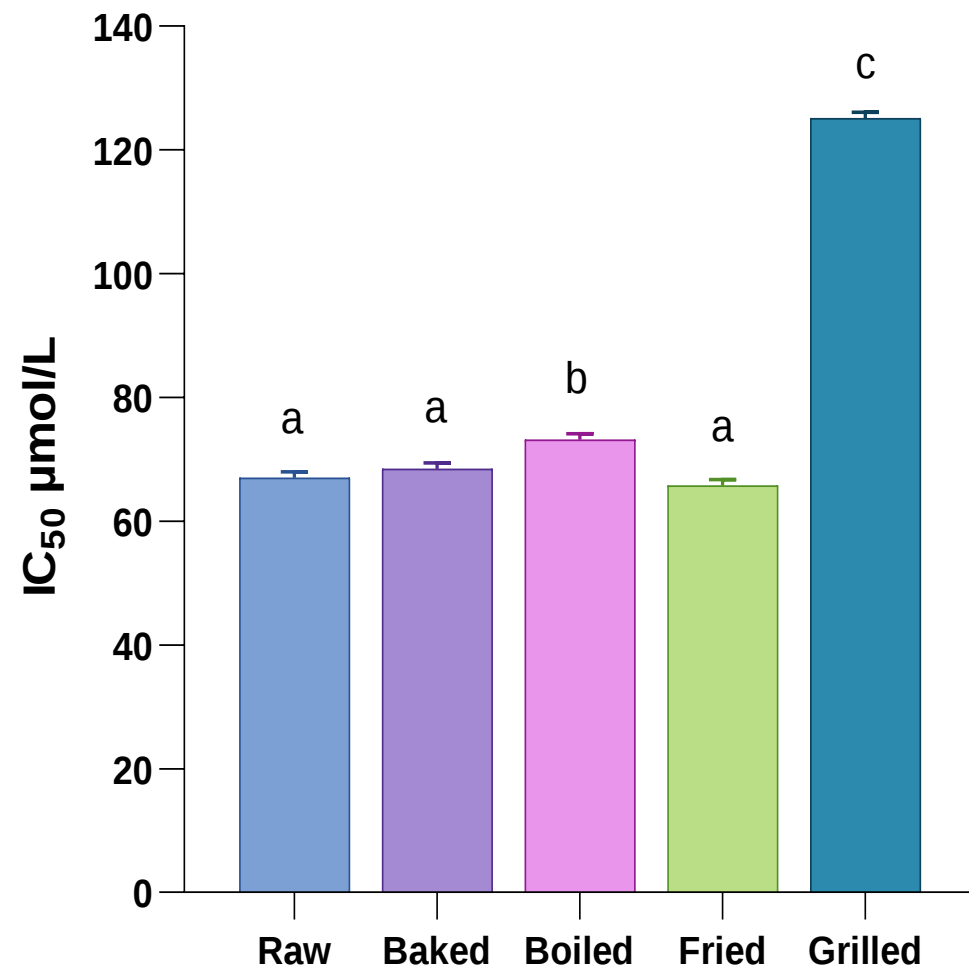
**BLOOD GLUCOSE
LEVEL**



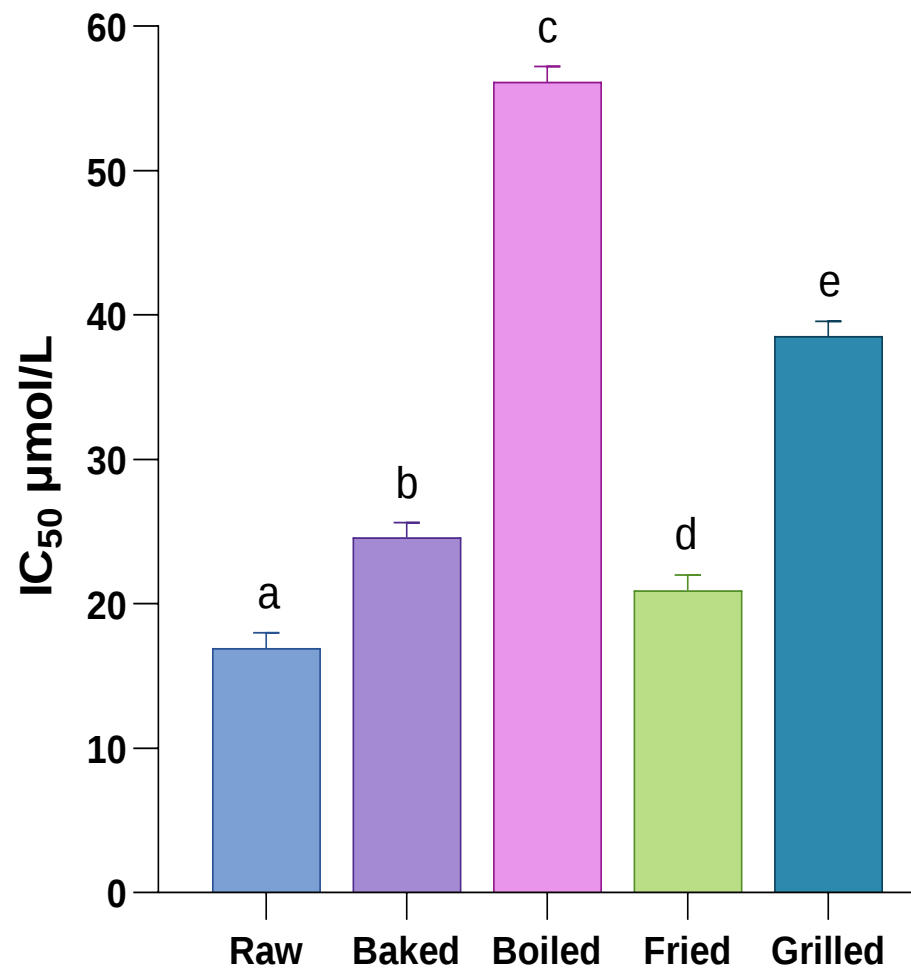
2nd YEAR – BIOACTIVITY STUDIES RESULTS



Results are shown in graphs



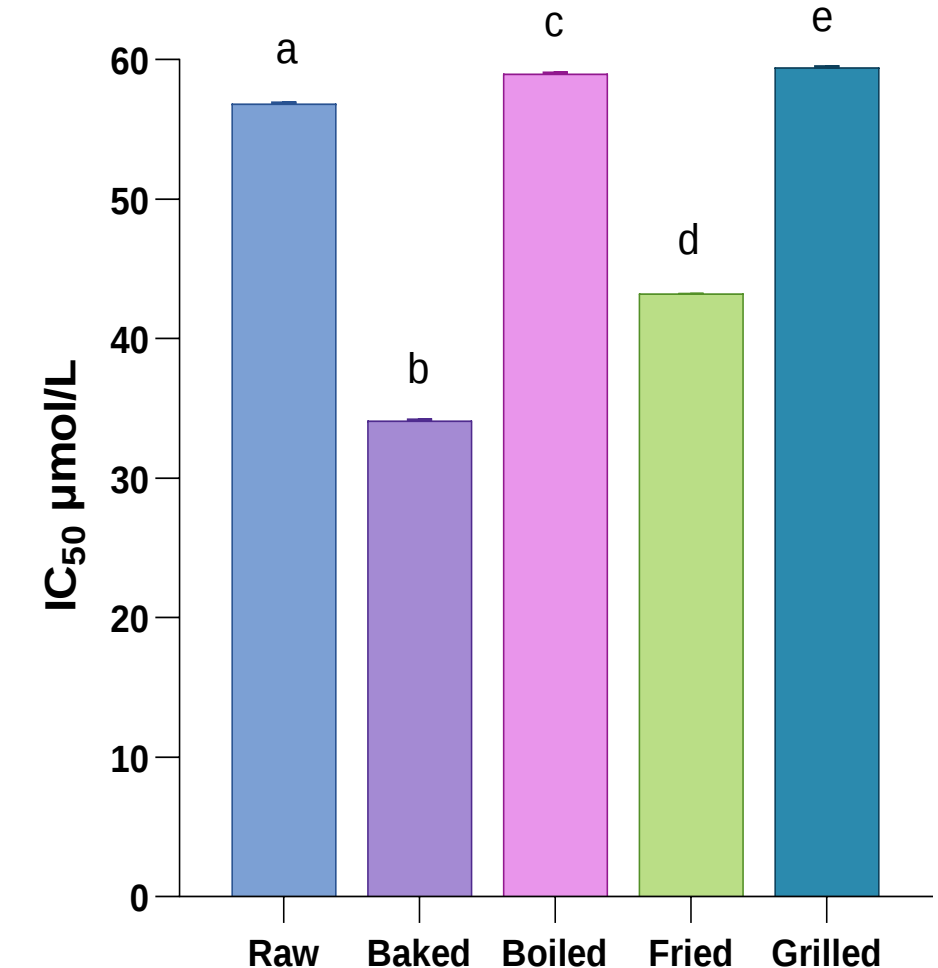
α-amylase inhibitory activity



α-glucosidase inhibitory activity



No significant results

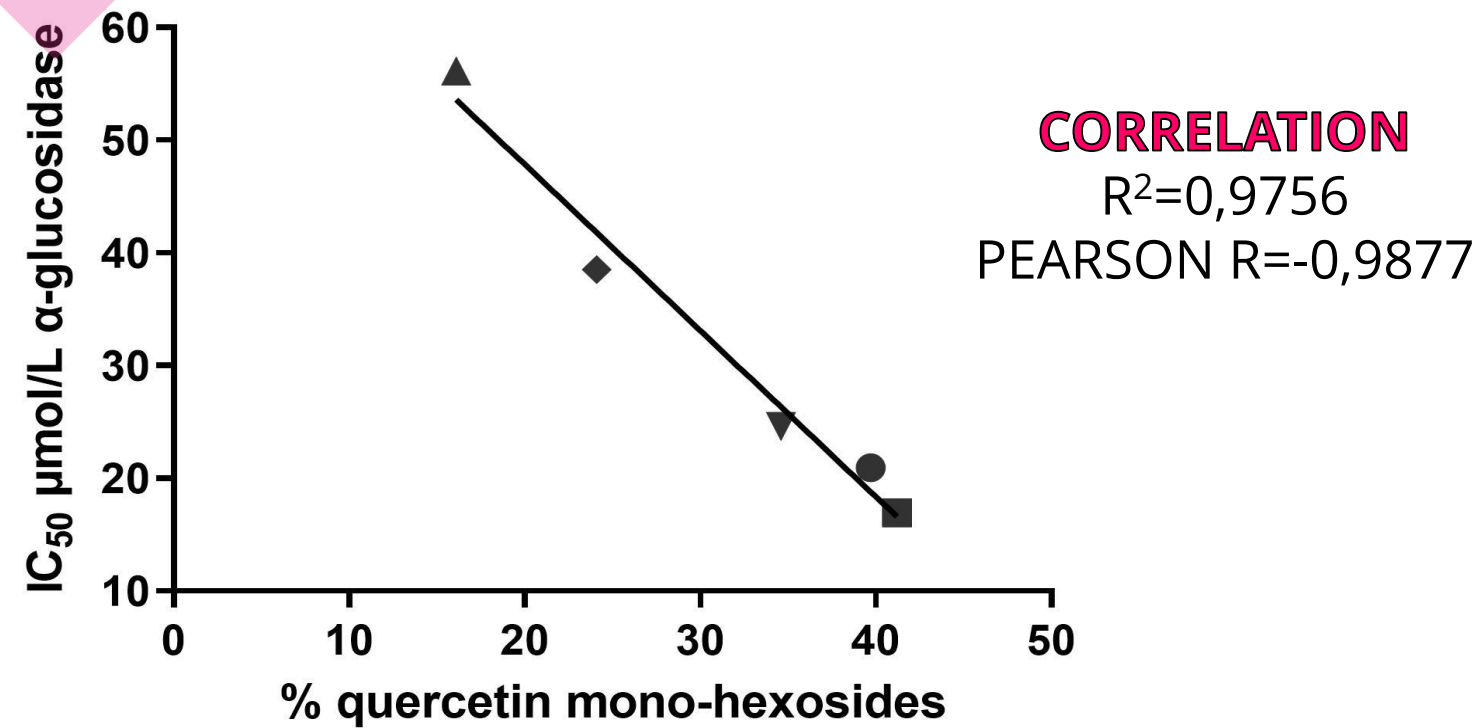


DPP-IV inhibitory activity

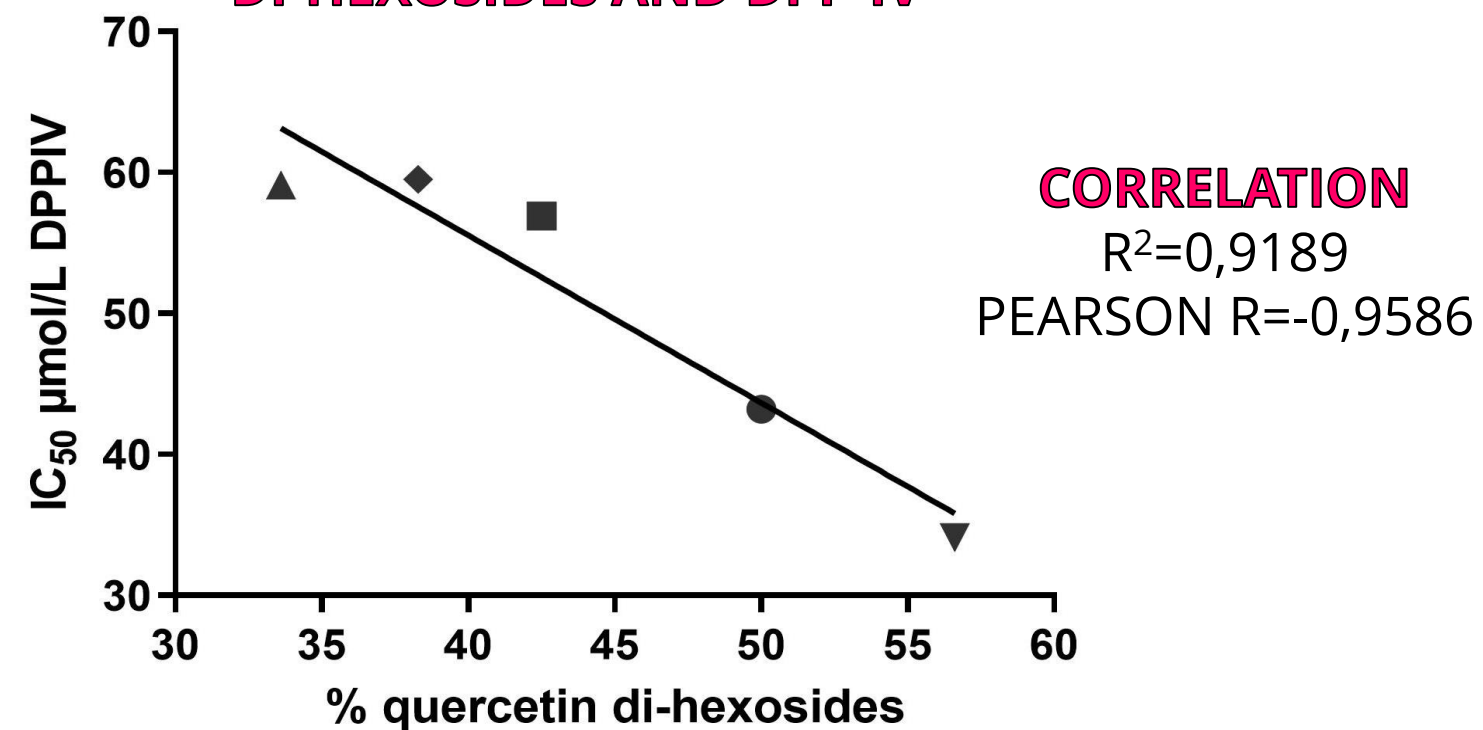
The concentration of phenolic compounds required to inhibit the activity of the enzymes by 50% (IC₅₀) was calculated by correlating the percentage of the enzyme inhibition with the phenolic compounds concentration (base-10 logarithm). The amount of phenolic compounds was determined by LC-ESI-IT MS/MS analysis.

2nd YEAR – STATISTICS

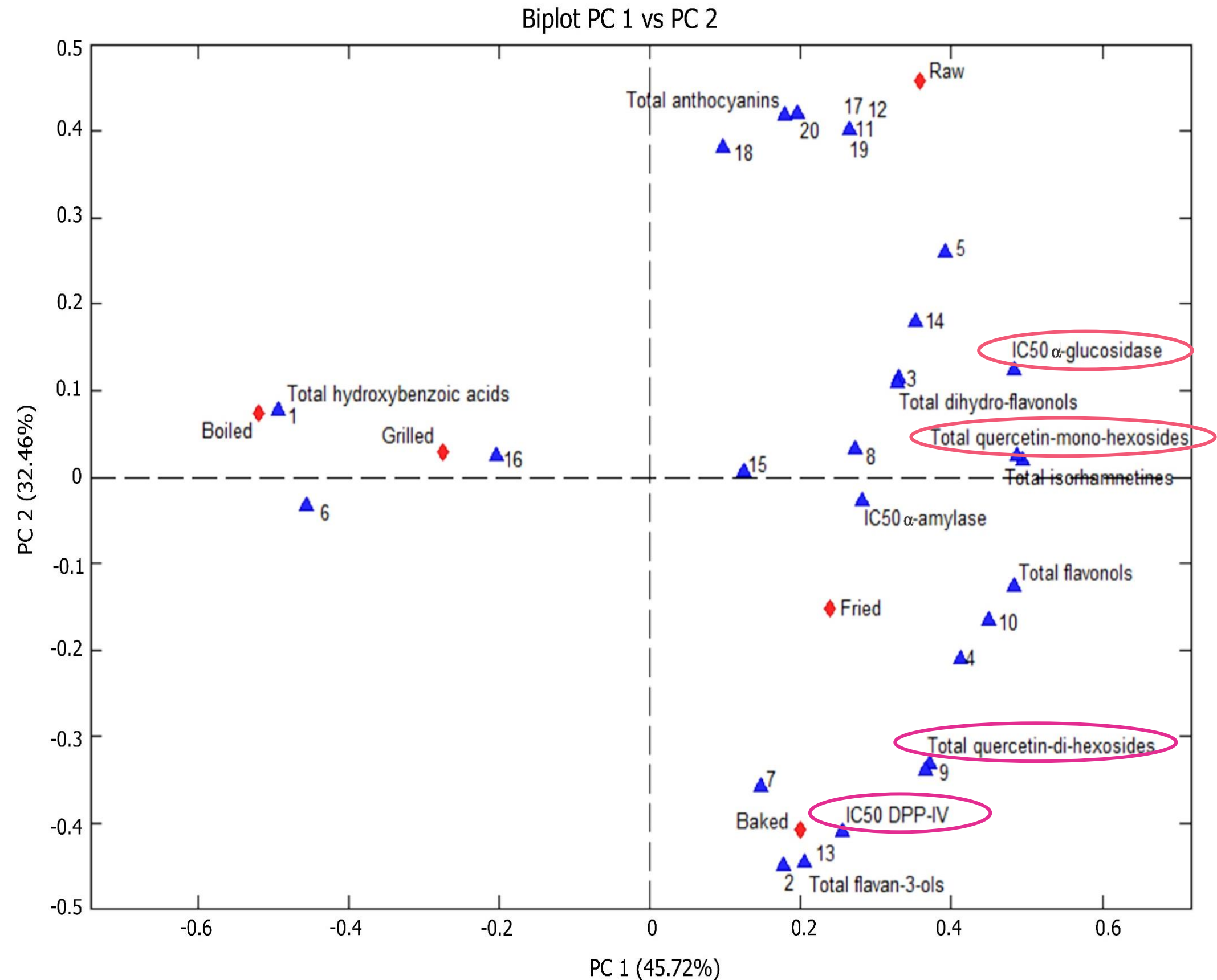
LINEAR REGRESSION MONO-HEXOSIDES AND α -GLUCOSIDASE



LINEAR REGRESSION DI-HEXOSIDES AND DPP-IV



PRINCIPAL COMPONENTS ANALYSIS (PCA)



TAKE-HOME MESSAGE

 Different heat treatment changes the phenolic composition of phenolic-rich matrices

 Some phenolic compounds are bioaccessible after cooking and *in vitro* gastro-intestinal digestion, others are degraded

 All red onion samples showed inhibitory activity against the three key enzymes involved in the pathogenesis of diabetes but with different extent depending on the cooking method and phenolic profile.

 The class of phenolic compounds most active against α -amylase, α -glucosidase and DPP-IV is the class of flavonols

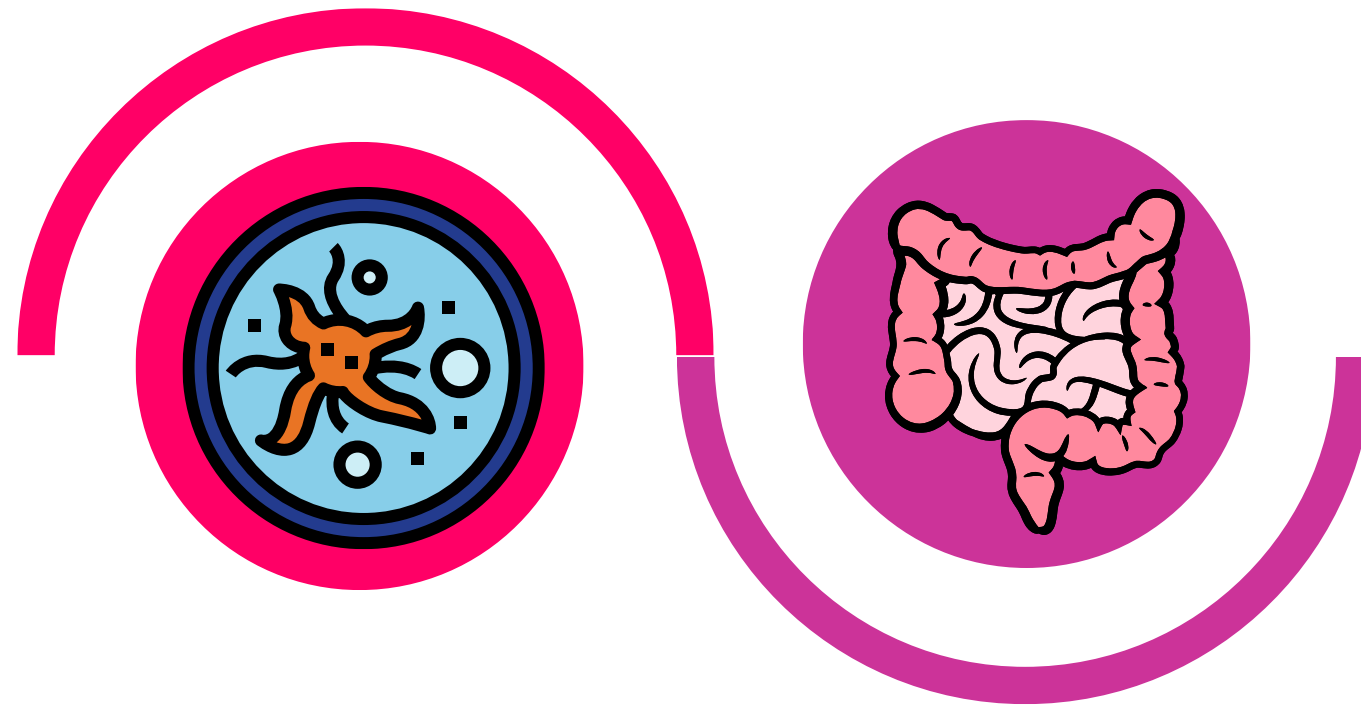
 Statistical analysis showed a positive relationship between the amount of quercetin mono-hexosides and the IC_{50} of α -glucosidase and between the amount of quercetin di-hexosides and the IC_{50} of DPP-IV

 The regular intake of foods rich in flavonols (such as red-skinned onion) can help prevent and improve metabolic syndrome

 A careful design of the cooking methods may be pivotal to suggest the most suitable process to optimize the release of specific phenolic compounds and the alleged bioactivities

3rd YEAR – FUTURE PERSPECTIVES

ANTIPROLIFERATIVE
ACTIVITY ON CANCER
CELLS

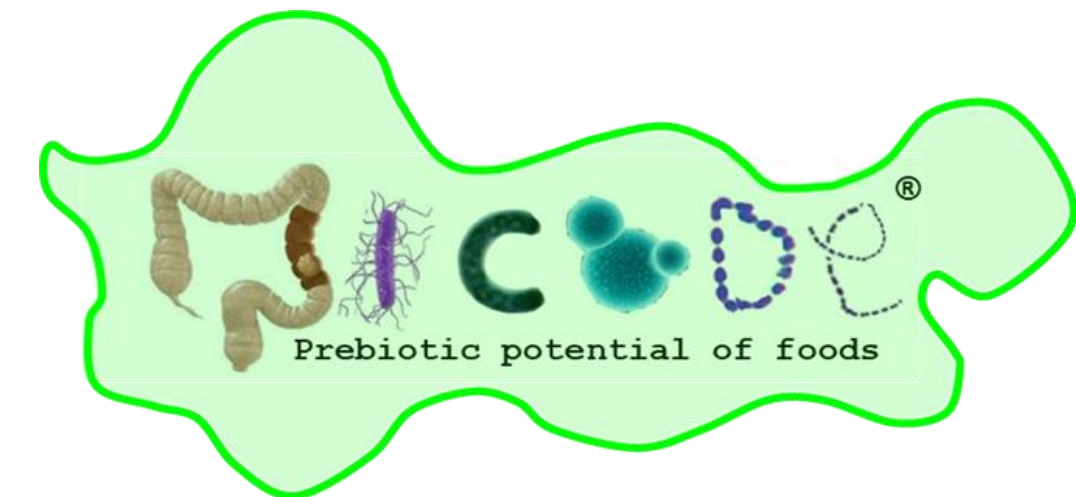


STUDY OF COLONIC
METABOLISM

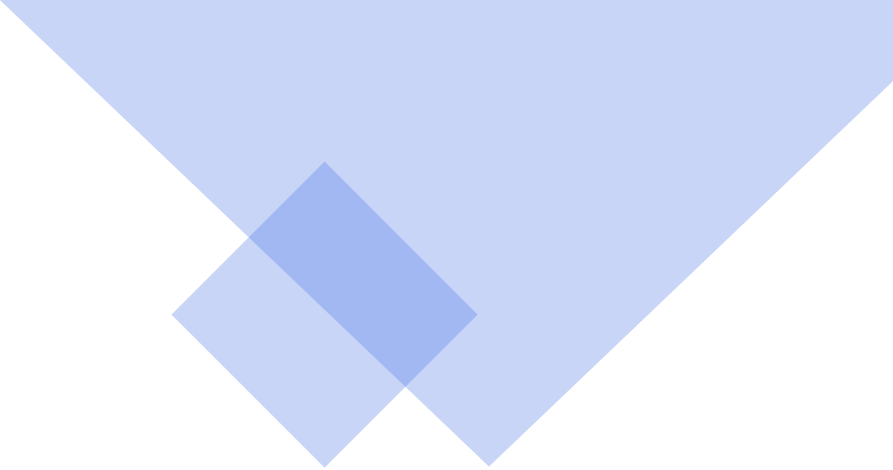
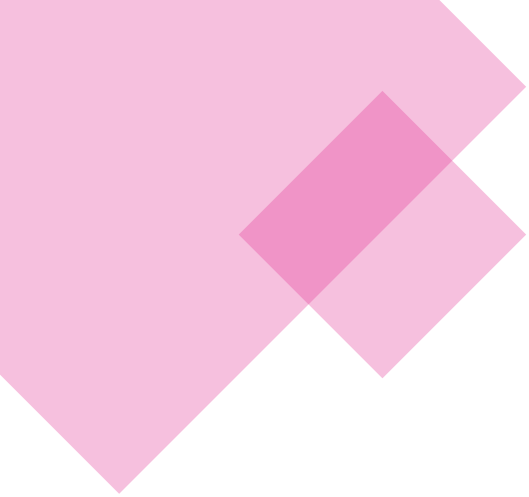
CEBAS
CENTRO DE EDAFOLOGÍA Y
BIOLOGÍA APLICADA DEL SEGURA

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

MURCIA (ES)



MULTI-UNIT *IN VITRO* COLON MODEL
Università di Bologna



THANKS FOR YOUR KIND ATTENTION !

ALICE CATTIVELLI
NUTRITIONAL BIOCHEMISTRY LAB
alice.cattivelli@unimore.it