

# How can the combination of pasta and wine affect the digestibility of polyphenols? A simulated digestion study to assess the meal antioxidant properties

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## Introduction

Pasta and wine are important components of the daily Mediterranean diet, being consumed worldwide. Both are a significant source of health beneficial antioxidant compounds, such as polyphenols. However, the effective antioxidant capacity (AC) of polyphenols requires that they are able to remain unaltered after the digestion and absorption processes, reaching the target organ. To our knowledge, there are no studies showing the impact of the simultaneous consumption of pasta and red wine on the bioaccessibility of their bioactive compounds. Because of this, the aim of this study was to verify changes in the AC of both pasta and wine when co-digested.

## Materials and methods

### Whole-wheat pasta

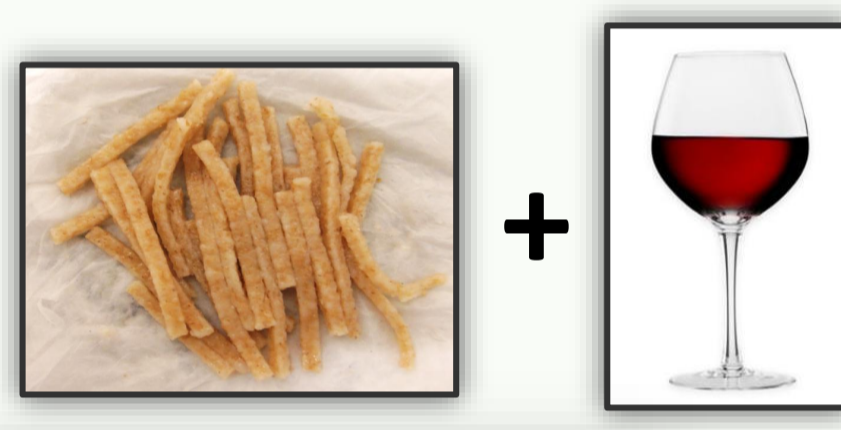


### SAMPLES

#### Red wine

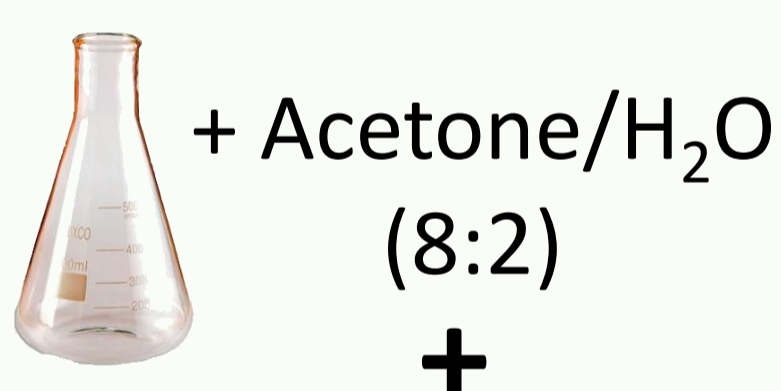


#### Pasta + wine (PW)



### POLYPHENOL EXTRACTION (Pasta and PW)

#### • Free fraction:



+ Acetone/H<sub>2</sub>O  
(8:2)

+

#### • Bounded fraction:



+ NaOH 2M  
+ HCl 37% p/v  
+ Ethyl ether/ethyl acetate  
(1:1)

### DIGESTION (GID)

#### ORAL (OD):

+ 2 mL human saliva (30 s)

#### GASTRIC (GD):

+ 12640 pepsin units  
(pH = 2), 37°C (2 h)

#### INTESTINAL (ID):

+ 3 mL pancreatin / pig bile  
in NaHCO<sub>3</sub> (pH = 7,5),  
37 °C (3h)

Intestinal absorption with dialysis  
membrane (DIA)

### DETERMINATIONS

#### -TOTAL POLYPHENOL CONTENT (TP):

(mg GAE/100g of fresh sample):

✓ **Folin-Ciocalteu Method**

#### -ANTIOXIDANT CAPACITY:

(mg TE/100 g fresh sample):

✓ **ABTS** (radical-scavenging capacity)

✓ **FRAP** (reducing power)

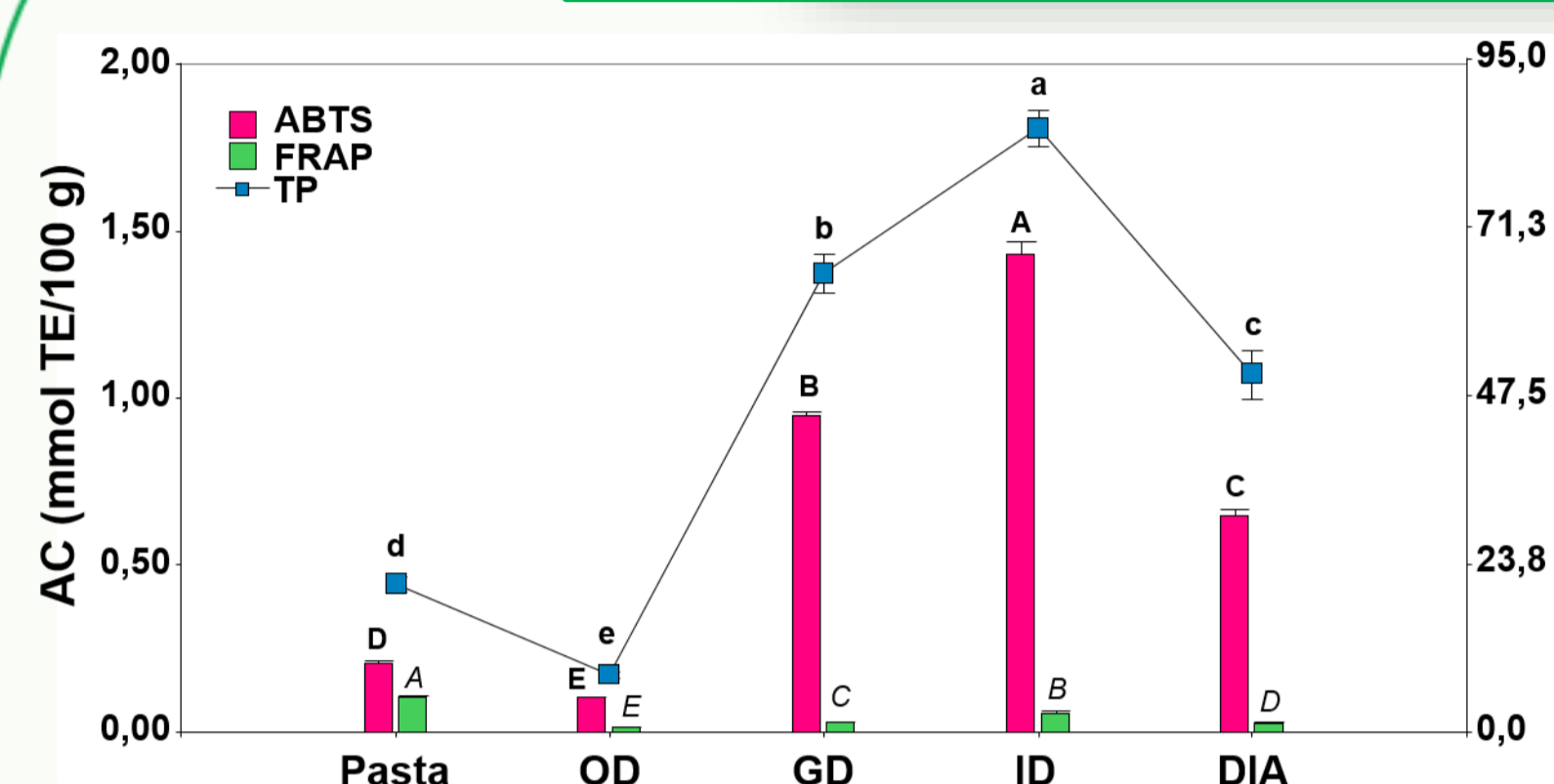
#### -POLYPHENOL PROFILE:



HPLC-DAD-Q-TOF  
(Agilent-Bruker)

## Results and discussion

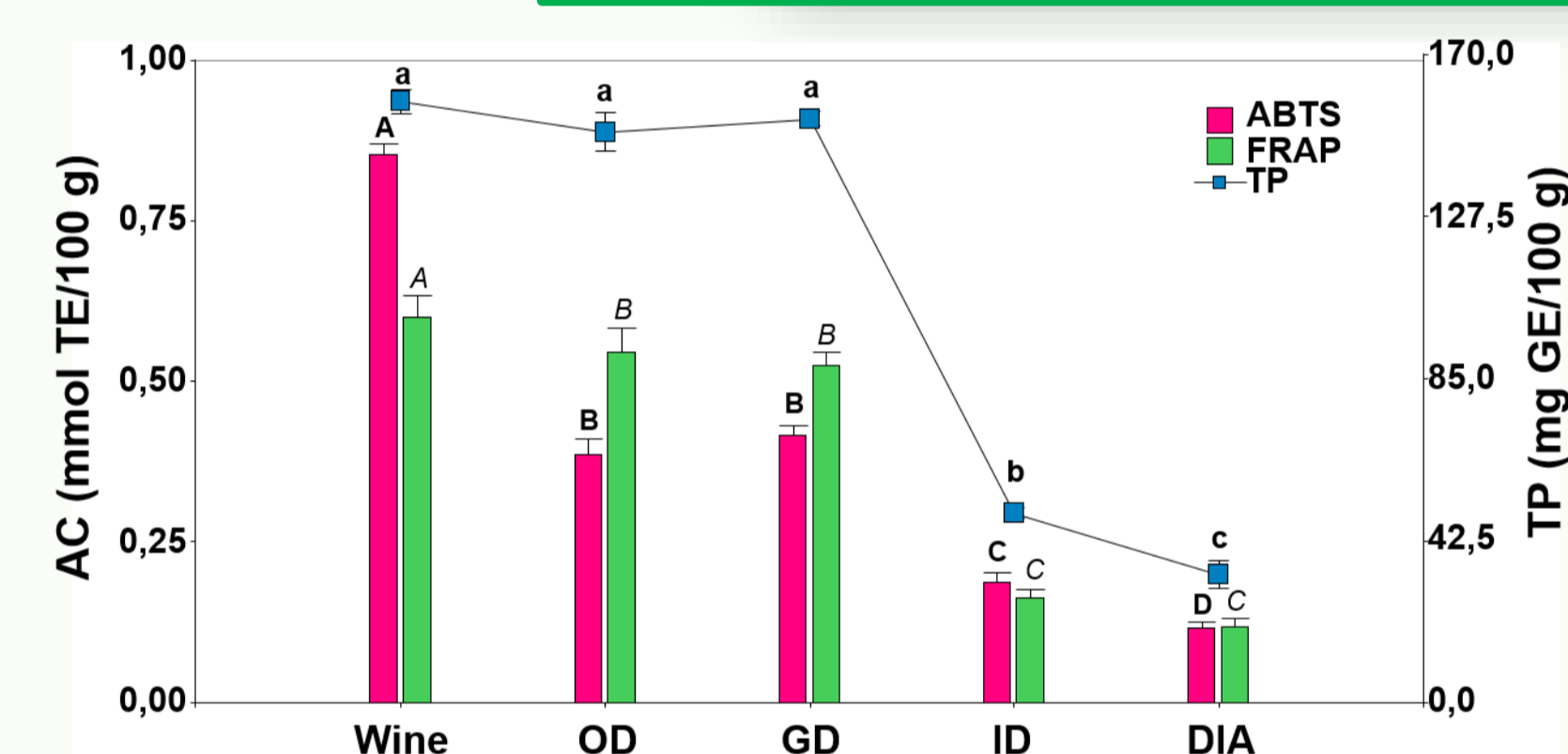
### ANTIOXIDANT PROPERTIES OF PASTA



**Figure 1.** TP, ABTS and FRAP in cooked pasta and along the simulated GID. Different letters indicate statistically significant differences ( $p < 0.05$ ) in each determination among samples.

- Twenty-three polyphenols were identified and quantified in pasta.
- Only 6 out of these 23 compounds could be quantified in ID. They were: HBADG, HBAG, Try, 8G6AA, 6G8AA, and DFA 6.
- These compounds were also quantified in DIA samples including *t*-FA.

### ANTIOXIDANT PROPERTIES OF WINE



**Figure 2.** TP, ABTS and FRAP in red wine and along the simulated GID. Different letters indicate statistically significant differences ( $p < 0.05$ ) in each determination among samples.

- Twenty-three polyphenols were identified and quantified in wine.
- Only 10 out of these 23 compounds could be quantified in ID. They were: CA, CouA, EG, FeA, Cat, Epi, Ast, QuerGlc, IsoQ, and SyrGlc.
- Nine out of the 23 compounds could be quantified in DIA. There were CA, CouA, FeA, Cat, Epi, Ast, LarGlc, QuerGlc, and SyrGlc.

### ANTIOXIDANT PROPERTIES OF PASTA AND WINE CO-DIGESTION

**Table 1.** Comparison of TP, ABTS and FRAP assays between experimental (PW exp) and estimated (PW est, pasta + wine) co-digestion results. Different letters indicate statistically significant differences ( $p < 0.05$ ) in each determination among PW exp and PW est.

Food	TP (mg GAE/100g)		ABTS (mmol TE/100g)		FRAP (mmol TE/100g)	
	PW exp	PW est	PW exp	PW est	PW exp	PW est
Food	70.94 ± 0.03 b	103 ± 2 a	0.47 ± 0.03 a	0.594 ± 0.009a	0.34 ± 0.03 a	0.40 ± 0.02 a
OD	26 ± 1 b	96 ± 3 a	0.25 ± 0.02 a	0.28 ± 0.01 a	(158 ± 1) × 10 <sup>-4</sup> b	0.34 ± 0.02 a
GD	85 ± 1 b	120 ± 1 a	1.145 ± 0.002 a	0.62 ± 0.01 b	0.128 ± 0.004 b	0.33 ± 0.01 a
ID	93 ± 7 a	64 ± 1 a	1.32 ± 0.01 a	0.67 ± 0.02 b	0.19 ± 0.02 a	0.123 ± 0.005 a
DIA	37.5 ± 0.5 a	41 ± 4 a	0.50 ± 0.03 a	0.32 ± 0.01 a	0.106 ± 0.005 a	0.08 ± 0.01 a

- When the PW exp are compared with PW est, the experimental co-digestion decreases the TP determined in food, OD, and GD, increases the ABTS in GD and ID steps, and decreases the FRAP in OD and GD.
- The DIA step didn't show differences in AC and TP between PW exp and PW est, however, differences in the bioaccessibility of some phenolics were found.
- In ID samples, an increase of HBADG, HBAG, 8G6AA, DCF 3, CafA, DimProc, MyrGlc, Ast, LarGlc, QuerGlc, and IsoGlc was observed in PW exp respect to PW est, while DFQ 6, FeA, and IsoQ were decreased.
- The PW exp increase the bioaccessibility of HBADG, 8G6AA, 6G8AA, DFA 3, GA, CA, CafA, EG, and DimProc with respect to PW est but decrease the bioaccessibility of DFA 6, *t*FA, and FeA.

## Conclusion

The consumption or co-ingestion of pasta with wine improves the antioxidant properties of these foods modifying the bioaccessibility of polyphenols pointing out the importance of further studies on co-digestion for different foods/beverages. To our knowledge, the current study is the first that provides valuable insights into the changes taking place during the simulated gastrointestinal digestion of a dish of pasta with a cup of red wine.