Development of a potential functional yogurt using bioactive compounds obtained from the by-product of the production of Tannat red wine

Victoria Olt [1], Jessica Báez [1], Santiago Jorcin [2], Tomás López [2], Adriana Fernández [1], and Alejandra Medrano [1]
1- Laboratorio de Bioactividad y Nanotecnología de Alimentos, Departamento de Ciencia y Tecnología de Alimentos, Facultad de Química, Universidad de la República, Uruguay.
2- Universidad Tecnológica del Uruguay, Instituto Tecnológico Suroeste Departamento de ciencia, procesamiento y tecnología de lácteos, La Paz, Colonia Piamontesa, Colonia, Uruguay

Introduction

Uruguay is one of the main producers of Tannat red wine [1] generating large amounts of grape pomace. This byproduct has high antioxidant capacity [2] having the potential to prevent the development of non-communicable diseases by its application as a functional ingredient [3]. The aim of this work was to encapsulate the phenolic compounds present in an ethanol extract derived from the skin of Tannat grape pomace by spray drying, for the development of a potential functional yogurt. In addition, it was also proposed to evaluate the bioaccessibility of the phenolic compounds by performing an *in vitro* simulation of digestion.

Methods

Results and Dissusion

Bioactivity of SYSTEMS before and after *in vitro* digestion

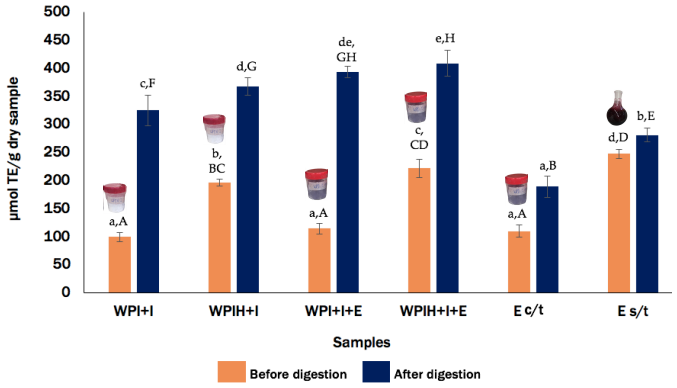

Figure 1. ORAC-FL before and after *in vitro* digestion of systems on a dry basis.

After *in vitro* digestion
- TPC content did not decrease ➡ phenolic compounds showed stability under gastrointestinal conditions.
- Antioxidant capacity of systems with encapsulating agents increased ➡ release of bioactive peptides with antioxidant capacity.
- Antioxidant capacity of the compounds presents in the non-encapsulated samples increased ➡ changes in the structure of the compounds, leading to an increase in their antioxidant capacity [6].

Bioactivity of YOGURTS before and after *in vitro* digestion

Table 1. Total polyphenol content (TPC), ABTS and ORAC-FL before and after in vitro digestion of yogurts.

Bioactivity	Y WPI+I	Y WPIH+I	Y WPI+I+E	Y WPIH+I+E	Y E s/t	Y E c/t	Y B
TPC (mg GAE/ g dry sample)	1.71±0.26^{bc,B}	1.69±0.11^{c,B}	1.58±0.06^{bc,B}	1.59±0.12^{bc,B}	1.43±0.21^{ab,AB}	1.44±0.12^{ab,AB}	1.23±0.27^{a,A}
	2.95±0.14^{a,C}	2.98±0.27^{a,C}	3.21±0.21^{b,CD}	2.94±0.14^{ab,CD}	3.36±0.08^{b,D}	3.16±0.14^{ab,CD}	3.31±0.07^{b,D}
ABTS (μTrolox/ g dry sample)	4.44±1.14^{a,A}	21.21±1.78^{c,A}	5.53±0.96^{b,A}	24.45±1.32^{c,A}	5.58±0.76^{a,A}	3.78±1.55^{ab,A}	1.59±0.35^{a,A}
	173.97±1.32^{bc,CE}	161.23±15.91^{bc,CD}	183.99±22.65^{c,DE}	74.36±8.43^{a,B}	170.36±3.74^{b,C}	152.44±5.17^{bc,DE}	164.44±14.51^{bc,CD}
ORAC-FL (μTrolox/ g dry sample)	1.46±0.43^{ab,A}	6.01±0.14^{d,AB}	2.57±0.26^{c,A}	12.57±0.61^{e,B}	2.01±0.21^{ab,A}	1.44±0.16^{bc,A}	1.15±0.05^{a,A}
	99.34±6.51^{cd,FG}	46.47±2.07^{a,C}	94.06±7.01^{bcd,EF}	83.94±3.43^{b,D}	89.83±6.38^{b,D}	85.63±4.45^{bc,DE}	104.72±7.22^{d,G}

After *in vitro* digestion
- TPC increased ➡ generation of milk protein hydrolysates that interfere with the assay [7].
- Antioxidant capacity increased ➡ under digestion conditions the yogurt proteins may be hydrolyzed by the digestive proteolytic enzymes generating bioactive peptides with antioxidant capacity [8].

Conclusions

In conclusion, the antioxidant capacity determined in the developed yogurts with the encapsulated extract by spray drying, represent encouraging results to continue with the valorization of the by-product of the Uruguayan wine industry. Further studies regarding other bioactive properties as well as sensory analysis should be addressed on the different yogurt formulations.

ACKNOWLEDGEMENTS:

REFERENCES: 1. INAVI ESTADISTICAS DE VIÑEDOS - DATOS NACIONALES 2019; Canelones, 2019. **2.** Beres, C.; Costa, G.N.S.; Cabezudo, I.; da Silva-James, N.K.; Teles, A.S.C.; Cruz, A.P.G.; Mellinger-Silva, C.; Tonon, R. V.; Cabral, L.M.C.; Freitas, S.P. Towards integral utilization of grape pomace from winemaking process: A review. Waste Manag. 2017, 68, 581–594. **3.** Zhang, H.; Tsao, R. Dietary polyphenols, oxidative stress and antioxidant and anti-inflammatory effects. Curr. Opin. Food Sci. 2016, 8, 33–42. **4.** Fernández-Fernández, A.M.; Iriondo-DeHond, A.; Dellacassa, E.; Medrano-Fernandez, A.; del Castillo, M.D. Assessment of antioxidant, antidiabetic, antiobesity, and anti-inflammatory properties of a Tannat winemaking by-product. Eur. Food Res. Technol. 2019, 245, 1539–1551. **5.** Agnetti, C.; Jorcín, S.; Medrano, A.; López, T. Encapsulation of whey protein isolate hydrolysate by spray drying as delivery systems in functional foods. In Proceedings of the In Proceedings of the 1st Ibero-American Congress of Bioactive Peptides (CIAPep); Campinas, 2019. **6.** Gumienna, M.; Lasik, M.; Czarnecki, Z. Bioconversion of grape and chokeberry wine polyphenols during simulated gastrointestinal in vitro digestion. Int. J. Food Sci. Nutr. 2011, 62, 226–233. **7.** Ky, I.; Lorrain, B.; Kolbas, N.; Crozier, A.; Teissedre, P.L. Wine by-Products: Phenolic characterization and antioxidant activity evaluation of grapes and grape pomaces from six different French grape varieties. Molecules 2014, 19, 482–506. **8.**Fernández-Fernández, A.M.; Dumay, E.; López-Pedemonte, T.; Medrano-Fernandez, A. Bioaccessibility and Cell Metabolic Activity Studies of Antioxidant Low Molecular Weight Peptides Obtained by Ultrafiltration of α Lactalbumin Enzymatic Hydrolysates. Food Nutr. Sci. 2018, 09, 1047–1065.