PHYSICOCHEMICAL INTERACTIONS BETWEEN FLAVONOIDS/ POLYSACCHARIDES FROM INDUSTRIALIZED CITRUS PRODUCTS (*Citrus limetta Risso, Citrus aurantium*)

Estrada Sierra N. A.[b], Padilla Camberos E.[a,b], Bravo S.[a], Lugo Cervantes E. [a,b], Cervantes Martínez J.[a,b], Villanueva Rodríguez S.J.*[a,b].

a Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, Av. Normalistas No. 800, Colinas de la Normal, CP. 44270, Guadalajara, Jalisco, México.

b Posgrado Interinstitucional en Ciencia y Tecnología (PICYT), sede Guadalajara Jalisco, México. *svillanueva@ciatej.mx

Introduction

The concern for the well-being and health of the consumers are the main motivation of the modern food industry (Parada & Aguilera, 2007), which intends to create food with any biological effect, called functional. However, to develop a good functional food, it need to ensure that ingredient, who has the biological effect, reaches the absorption site in the intestine and it is absorbed. Like all citrus, bitter orange and sweet lime are a rich source of flavonoids like hesperidin (Hesp), eriocitrin (Erio), naringin (Nar) and neohesperidine (NH) and others, which coupled with its perfumed notes make them interesting as nutraceutical ingredient or functional food. However, both flavonoids such as volatile compounds are unstable to temperature, pH changes, presence of ion, or other factors of the process, formulation or handling and storage. (Barreca et al., 2011 a,b) To industrialize a product, it is essential to add some substances that contribute to stability and maintain or potentializing sensory characteristics, these factors are determinants for consumption and acceptance. One substance widely used for stabilizing flavor, masking undesirable flavors or protect labile compounds, is the β-cyclodextrin (β-CD). It is also known that pectins have a masking effect on the bitter taste of the flavonoid (Le Bourvellec et al., 2005). Few studies have focused on understanding and quantifying the interaction between these compounds.

Objective

Explore in a controlled manner (model system) the chemical or physicochemical interactions between some polysaccharides present in the food and some of the flavonoids reported for lime and sour orange.

Methodology

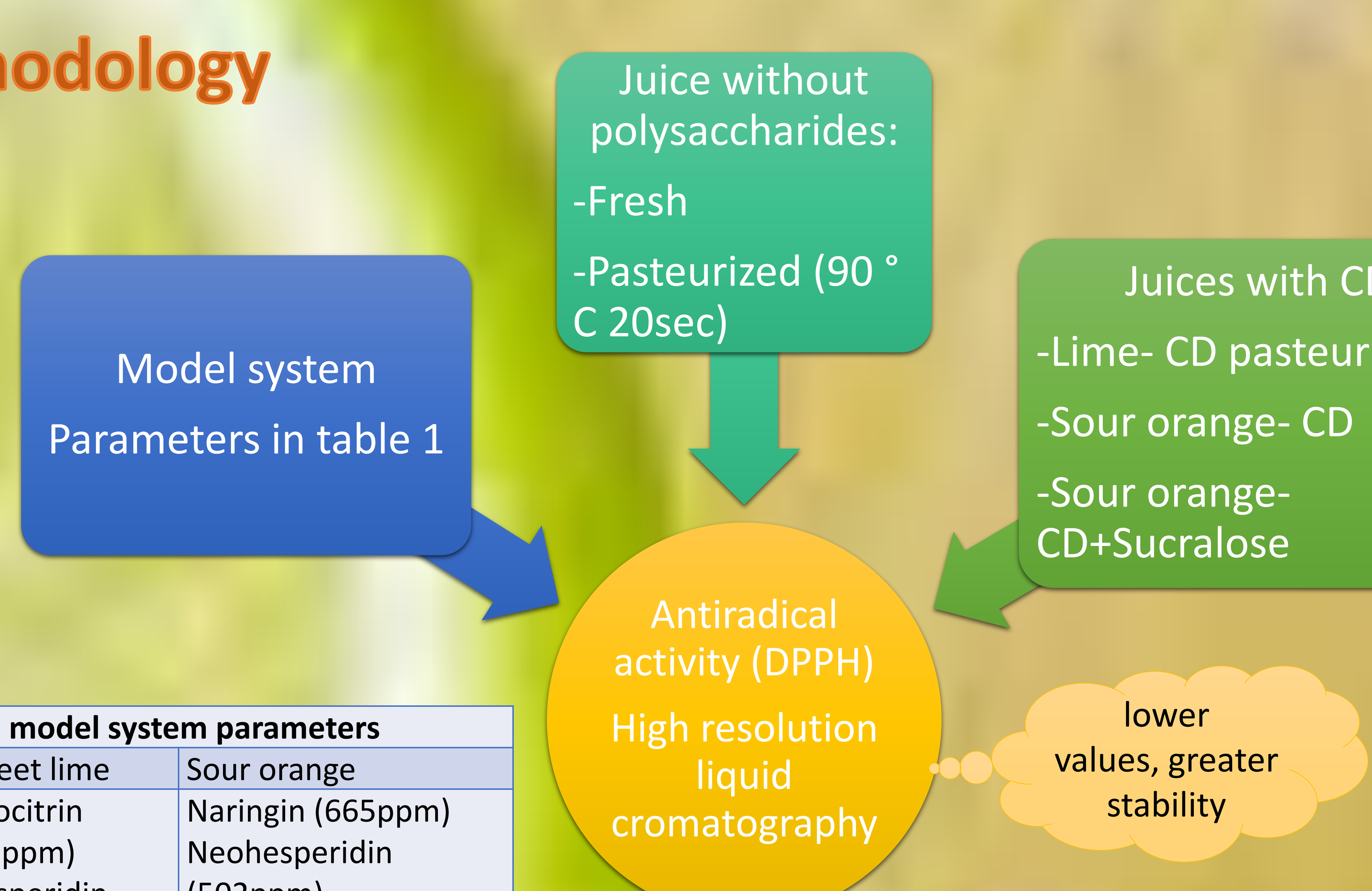

Table 1. model system parameters		
Parameters	Sweet lime	Sour orange
Flavonoids	Eriocitrin (17ppm) Hesperidin (527ppm)	Naringin (665ppm) Neohesperidin (502ppm)
pH	5-5.6	2.7-4
sucralose	Without	30mg/100ml
Pectin	0.095mg/100ml	
CD	Equimolar concentration	

Results

In the model system, shows that eriocitrin and hesperidin have similar values (figure 1), but, considering the eriocitrin concentration, may be inferred that the flavonoid that has a higher antioxidant capacity in the lime model system was the eriocitrin. While in the sour orange was neohesperidine which shows the highest %I DPPH radical (figure 2).

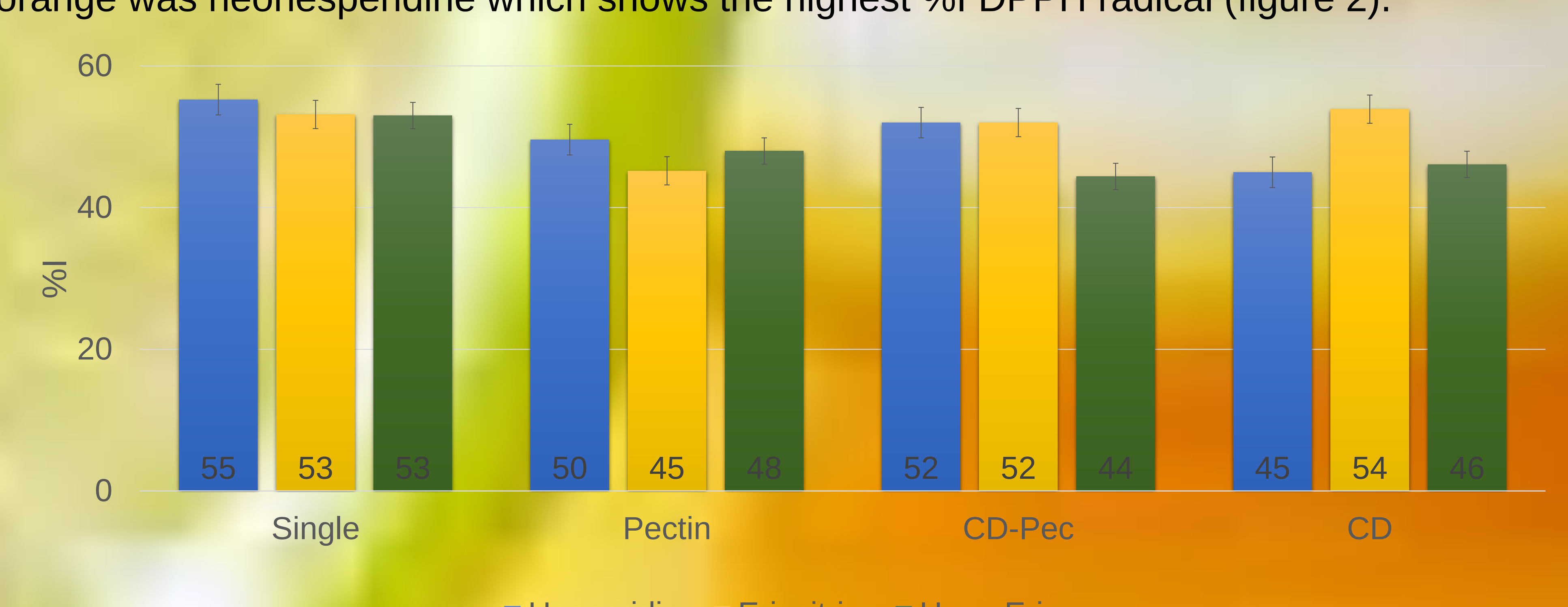

Figure 1 antiradical capacity (% I) of some representative solutions of the sweet lime model system: Hesperidin (528ppm), eriocitrin (17ppm), Hesp-Erio at pH 5.6 and 90 ° C.

Eriocitrin and naringin apparently formed a more stable interaction by adding pectin (Figure 1,2), this is reflected in the concentration of free flavonoids found in HPLC. Eriocitrin and naringin apparently formed a more stable interaction by adding pectin, this is reflected in the concentration of free flavonoids found in HPLC. For hesperidin and neohesperidin (Figure 1, 2) formed a more stable interaction with CD.

In the sour orange model system (Figure 2), the solution form more stable interactions of all the system model is the mixture of flavonoids with βCD. By adding sucralose to the solutions to try to simulate the sour orange juice, was seen an even greater decrease in the %I DPPH radical of all solutions, regardless of the type of flavonoid or polysaccharide, however the largest decrease can be detected in solutions containing β-CD, being the Nar-NH/CD-sucralose solution which reported that lower concentration of flavonoids by HPLC.

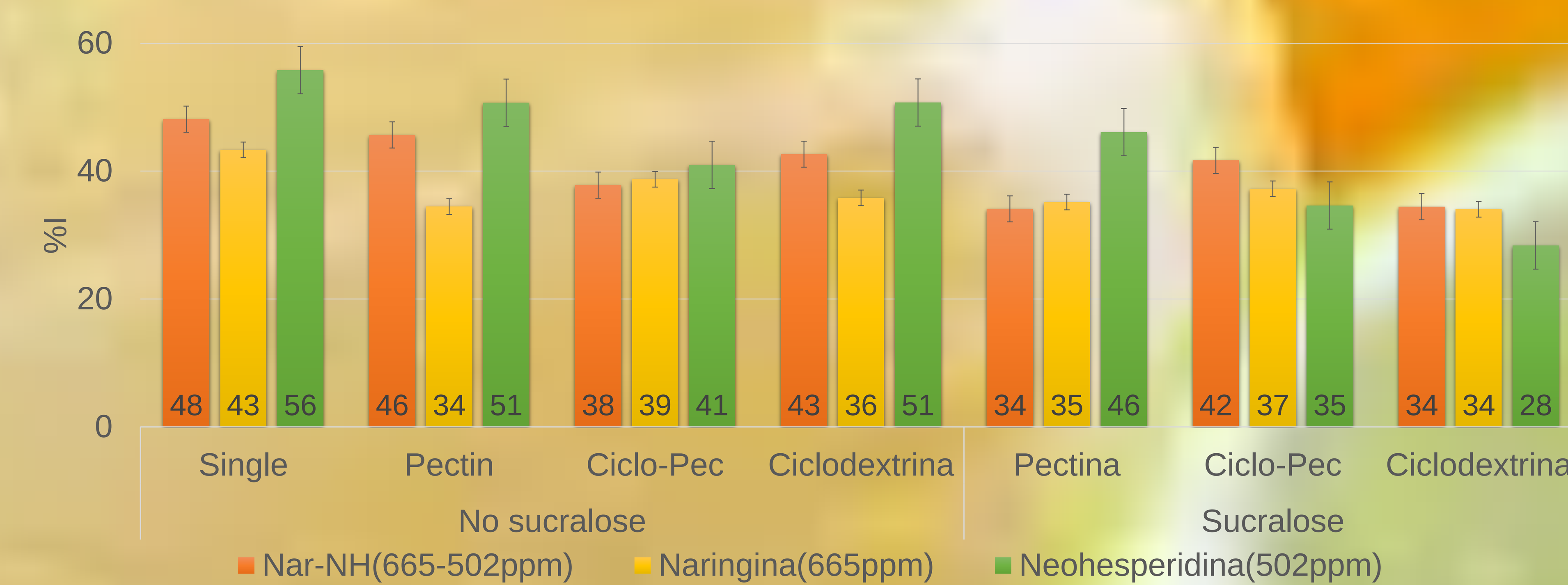

Figure 2 antiradical capacity (% I) of some representative solutions of sour orange model system: Naringin (665ppm), Neohesperidin (502ppm), Nar-NH at pH 4 to 90 ° C.

In the case of juices (figure 3), lime juices was no significant differences by subjecting to the different types of conservation, however, in sour orange juices was a significative increase in the %I DPPH radical when was pasteurized. By adding sucralose juice there was a decrease in the %I no matter if it is pasteurized or not, the interaction become stronger when β-cyclodextrin is added, this this agrees with the findings in the model system.

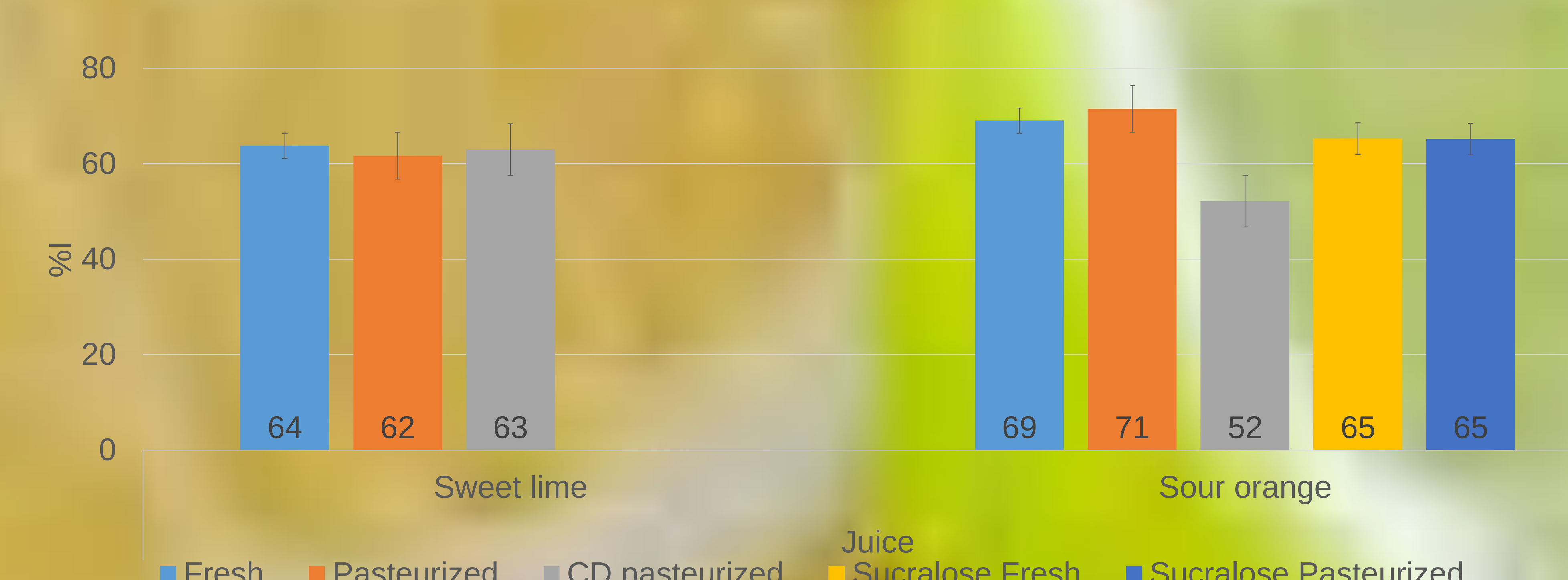

Figure 3 antiradical capacity (% I) of sour orange and lime fresh juices, pasteurized, sucralose and βCD. *In sour orange, the juice whit CD also has sucralose.

Conclutions

There will be interactions between the compounds in the food matrix and flavonoids; these interactions affect the availability of the same. For flavonoids studied in this work, environmental factors such as pH and temperature have no effect on the availability of these into the matrix. Both pectin as the β-CD appear to form interactions with flavonoids, however, the most stables interaction were form whit β-CD, this interactions were by the formation of hydrogen bonds or hydrophobic interaction, the mixture of these polysaccharides seems to favor the formation of interactions between them, showing no significant change in the stability of the interaction complex. To determine whether these interactions modify the biological effect of these compounds further research is required.

Bibliography

- Barreca, D., Bellocco, E., Caristi, C., Leuzzi, U., & Gattuso, G. (2011a). Distribution of C- and O-glycosyl flavonoids, (3-hydroxy-3-methylglutaryl)glycosyl flavanones and furocoumarins in Citrus aurantium L. juice. *Food Chemistry*, *124*(2), 576–582.
- Barreca, D., Bellocco, E., Caristi, C., Leuzzi, U., & Gattuso, G. (2011b). Flavonoid profile and radical-scavenging activity of Mediterranean sweet lemon (Citrus limetta Risso) juice. *Food Chemistry*, *129*(2), 417–422.
- Le Bourvellec, C., Bouchet, B., & Renard, C. M. G. C. (2005). Non-covalent interaction between procyanidins and apple cell wall material. Part III: Study on model polysaccharides. *Biochimica et Biophysica Acta*, *1725*(1), 10–8. doi:10.1016/j.bbagen.2005.06.004
- Parada, J., & Aguilera, J. M. (2007). Food microstructure affects the bioavailability of several nutrients. *Journal of Food Science*, *72*(2)
- Nguyen, T. A., Liu, B., Zhao, J., Thomas, D. S., & Hook, J. M. (2013). An investigation into the supramolecular structure, solubility, stability and antioxidant activity of rutin/cyclodextrin inclusion complex. *Food Chemistry*, *136*(1), 186–92.