ANTIOXIDANT CAPACITY AND ANTIBACTERIAL ACTIVITY OF SEA BUCKTHORN (*HIPPOPHAE RHAMNOIDES* L.)

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Abstract
Consumer behavior changed a lot in the last few years. The chemicals used in food production discourage consumers, but protection against spoilage and pathogenic microorganisms is crucial, because they are important from medical and economic perspectives. Among research topics related to novel, minimally processed techniques using natural components, sea buckthorn is less studied. In spite of its widespread application and beneficial effects the potential of sea buckthorn is not completely explored.

Antioxidant capacity and antibacterial activity of commercially available sea buckthorn products (sea buckthorn instant tea, sea buckthorn tea, sea buckthorn powder, berry and juice) were determined. FRAP (Ferric Reducing Ability of Plasma) method, and TPC method with Folin-Ciocalteu reagent (Total Polyphenol Content) were applied for antioxidant capacity measurements. Antibacterial activity was tested against *Escherichia coli, Enterococcous faecalis, Listeria innocua, Listeria monocytogenes, Pseudomonas aeruginosa* and *Staphylococcus aureus* by using agar well diffusion method.

The obtained results highlighted that not only the active substance content of products but also the preparation techniques (water temperature, time of infusion) significantly influence the antioxidant capacity and antibacterial activity. Higher water temperature in case of tea preparation resulted better antibacterial activity and higher antioxidant capacity. In case of sea buckthorn powder, longer infusion time proved to be more efficient. Products with higher antioxidant capacity showed better antibacterial activity by agar well diffusion method. In case of berry and berry juice, high antioxidant capacity and excellent antibacterial activity were determined.

Introduction
Sea buckthorn, also known as *Hippophae rhamnoides* L., is an Eurasian plant belongs to the *Eleaganceae* family, originally found on the slopes of the Himalayas [1]. Today we can find it in the Alps and on the northern shores. This plant has a rich history in natural medicine [2], due to their high content of bioactive compounds [3]. Sea buckthorn is good sources of valuable nutrients (carotenoids, tocopherols, phytosterols, phenolic acids and flavonoids), demonstrating various useful effects (antioxidant, antimicrobial) [4-6]. The aim of this study was to find commercially available sea buckthorn products and process them under aseptic conditions while examining the antibacterial effect and antioxidant capacity of the products, to explore relationships between them. I process them by taking the preparation methods recommended by the manufacturer / distributor (time of infusion, temperature).

Experimental

FRAP method, and TPC method were applied for antioxidant capacity measurements [7-8]. FRAP was defined in ascorbic acid equivalent (μg ascorbic acid equivalent/ g). TPC was determined according to the Folin–Ciocalteu spectrophotometric method described by Singleton and Rossi. Results were specified in μg gallic acid equivalent/ g. Antibacterial activity was tested against *Escherichia coli*, *Enterococcous faecalis*, *Listeria innocua*, *Listeria monocytogenes*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* by using agar well diffusion method. The commercially available products were sea buckthorn instant tea, sea buckthorn tea, sea buckthorn powder, berry and juice. I used two types of preparation for the instant sea buckthorn tea. I resolved the product in cold and in 60 °C water too. In case of the sea buckthorn tea I used cold and 90 °C water. I brewed the tea in cold water 24 hours for the first preparation and 15 minutes for the second one. The third preparation of the tea I brewed in 90 °C water for 15 minutes and then removed with filter paper. The powder were once soaked in cold water for 24 hours and the other one for 15 minutes and then removed by centrifuge.

Results and discussion

Antibacterial activity tested by using agar well diffusion method. In the case of sea buckthorn tea, the cold preparations (all 15 minutes and 24 hours of brewing) did not show complete inhibitory effect, only partially, while in the case of the tea brewed at 90 °C, I have already experienced zones of inhibition in most places. In the case of cold instant tea, there was a zone of inhibition for all bacteria, but instant tea brewed at 60 °C resulted larger zones. In case of sea buckthorn powder, 15 minutes of soaking was not enough to release the inhibitory components, only of *Listeria innocua*. The 24 hour sea buckthorn powder was better, however, inhibition was not significant (less than 10 mm).

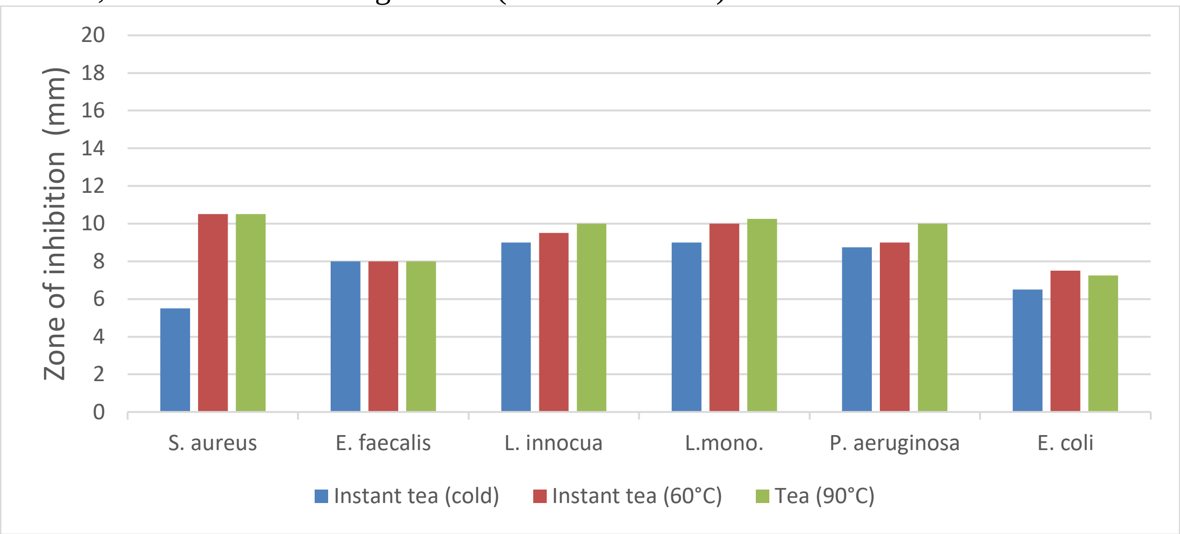

Figure 1. Inhibition zones of agar well diffusion method (tea, instant tea)

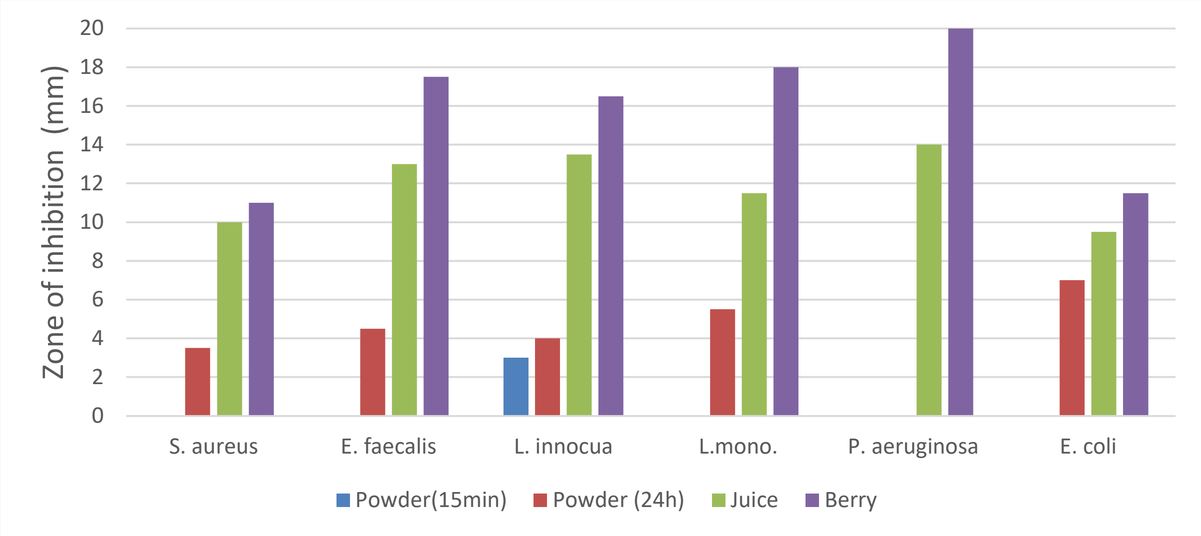

Figure 2. Figure 1. Inhibition zones of agar well diffusion method (powder, juice, berry)

FRAP method, and TPC method with Folin-Ciocalteu reagent were applied for antioxidant capacity measurements. The results show that the tea brewed at 90 °C has very good antioxidant capacity and instant teas have also high. (Figure 3.). In case of instant tea, the originally added vitamin C could have slightly influenced the result. Higher temperature affected the antioxidant compounds in a positive way, because several more components could dissolve out from the tea, that increased the antioxidant capacity. It can be seen that these three results are close to each other. This is consistent with the results of agar well diffusion method, where their antibacterial effects also closely related. The FRAP method shows that the sea buckthorn berry has remarkably good values predicted by the agar well diffusion method (Figure 3.). The results also demonstrate the high polyphenol content of sea buckthorn berry and juice. The values of the sea buckthorn powder were not particularly prominent, but it can be seen that the longer soaked powder had better results (Figure 4.).

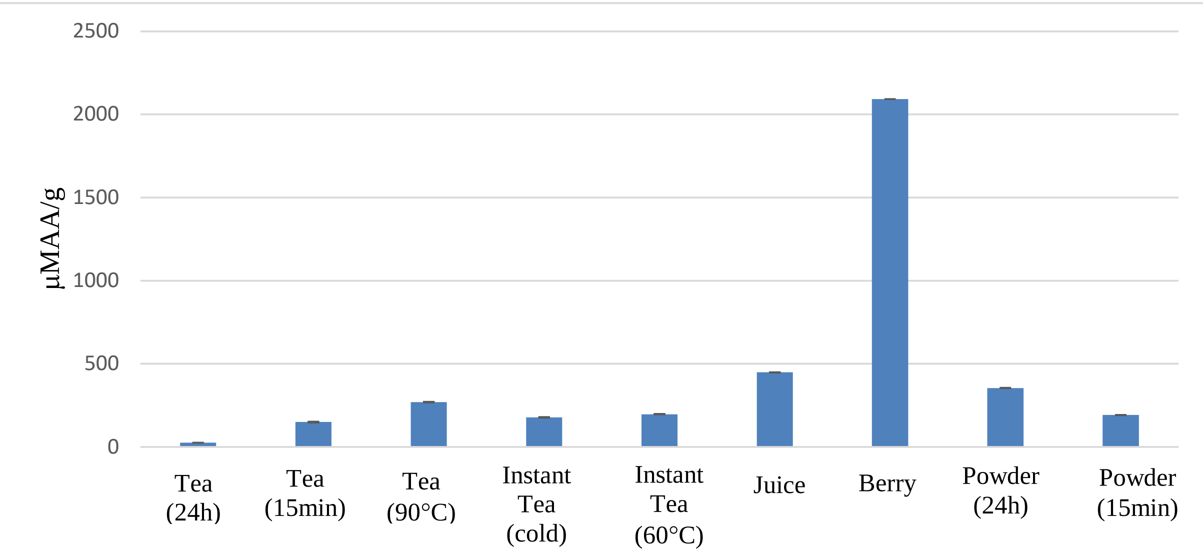

Figure 3. Ferric Reducing Ability of Plasma (FRAP), µg ascorbic acid equivalent/ g

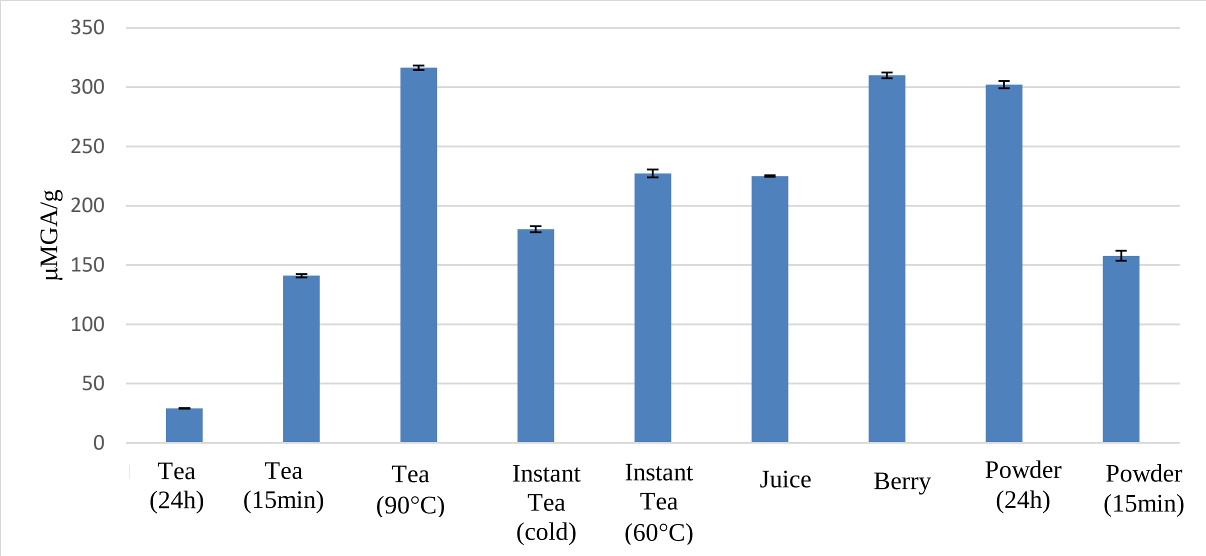

Figure 4. Total polyphenol content (TPC), µg gallic acid equivalent/ g

Conclusion

The obtained results highlighted that not only the active substance content of products but also the preparation techniques (water temperature, time of infusion) significantly influence the antioxidant capacity and antibacterial activity. Higher water temperature in case of tea preparation resulted better antibacterial activity and higher antioxidant capacity. In case of sea buckthorn powder, longer infusion time proved to be more efficient. Products with higher antioxidant capacity showed better antibacterial activity by agar well diffusion method. In case of berry and berry juice, high antioxidant capacity and excellent antibacterial activity were determined. In case of instant tea, the originally added vitamin C could have slightly influenced the result, both fo bacteriocid effect and antioxidant capacity.

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