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The Effect of High Pressure Processing on Antioxidant Activity of Irish Potato Cultivars †

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Abstract: The effect of High Pressure Processing (HPP) on Irish potato cultivars' antioxidant activity (AOA) was examined. High Pressure Processing at 600 MPa for 3 min was applied to two coloured (Rooster and Kerr's Pink) and two white (Saxon and Gemson) Irish potato varieties. Antioxidant activity was assayed spectrophotometrically by ferric reducing antioxidant power and diphenyl-1-picrylhydrazyl methods. No statistically significant ($p \geq 0.05$) change in antioxidant activity was observed in both the AOA methods irrespective of the HPP treatments, although a slight increase in the activity was noted in the majority of the HPP treated samples. This implies that HPP treatment has little role in improving the functional qualities, and can be tailored to improve the quality and safety of the commonly consumed potatoes.

Keywords: high pressure processing; potatoes; polyphenols; antioxidant

1. Introduction

Potatoes are amongst the most important crops grown for human consumption [1]. Potatoes constitute a staple nutritional diet worldwide, and are also considered as one of the richest sources of antioxidants in human diet [2]. Some of the antioxidants reported in the potatoes are polyphenols, ascorbic acid, carotenoids, tocopherols, alpha lipoic acid, and selenium [3].

In Ireland, there has been an increased sale of ready-to-eat processed potatoes as per the recent reports of the Irish Farmers' Association. As conventional food processing may have damaging effects on certain physical and sensory characteristics of food, and considering the high demand by the consumers for "fresh-like" products, the food industry is constantly seeking for new methods of processing and preservation that have less negative effects not only on the organoleptic properties but also on the nutritional and functional values of food and food products [4].

High pressure processing (HPP) is an emerging non-thermal technology and its applications in food industry, especially for the production of minimally processed food, are increasing each year [5]. Therefore, the aim of this work is to examine the effect of HPP on the functional value (i.e., antioxidant activity) of commonly consumed Irish potato cultivars' (Saxon, Gemson, Rooster and Kerr's Pink).

2. Materials and Methods

2.1. Samples

Freshly harvested potatoes (*Solanum tuberosum* L.) of Rooster cultivar were provided by Country Crest Ltd., Lusk, Co. Dublin. Saxon, Gemson and Kerr's Pink potatoes were purchased from a local market in Dublin, Ireland.

Chemicals for antioxidant assays: namely 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox), 2,4,6-tripyridyl-striazine, Iron(III) chloride hexahydrate, sodium acetate anhydrous, acetic acid, sodium hydroxide, hydrochloric acid, methanol, and 2,2-Diphenyl-1-picrylhydrazyl (DPPH) were purchased from Merck, Wicklow, Ireland.

2.3. HPP Treatment

Potatoes of the different cultivars were packaged in polyethylene/polyamide pouches and then vacuum sealed. HPP treatment was performed in HPP Tolling, St Margarets, Co. Dublin. A commercial-scale high pressure press was used (Hiperbaric 55HT, Hiperbaric Miami, FL, USA) at 600 MPa (6000 bar) for 3 min at 10. 6 °C (max. temperature reached).

2.2. Extraction of Antioxidants

Phenolic compounds were extracted according to Wang et al., 2015 [6] with minor modifications.

2.3. Determination of Antioxidant Activity (AOA)

Ferric Ion Reducing Antioxidant Power (FRAP) assay was performed according to Stratil, Klejdus and Kubáň, 2006 [7] and Ou et al., 2002 [8], while radical scavenging activity (2,2-Diphenyl-1-picrylhydrazyl—DPPH) assay was employed according to Goupy et al., 1999 [9] to evaluate the AOA of potato samples.

2.4. Statistical Analysis

Results are expressed as means of three replicates ± standard deviation (SD). All experimental data were analysed using paired samples t-test by SPSS Statistics 23. The values were considered significantly different when $p < 0.05$.

3. Results and Discussion

Effects of HPP on Antioxidant Activity (AOA) of Potatoes

The AOA of potatoes as evaluated by FRAP analysis is shown on Figure 1. AOA was increased ~12%, and 10% ($p < 0.05$) in HPP treated Saxon and Rooster potato samples, respectively compared to those untreated. However, there were no statistically significant changes in AOA of HPP treated Gemson and Kerr's Pink potato samples as compared to those untreated.

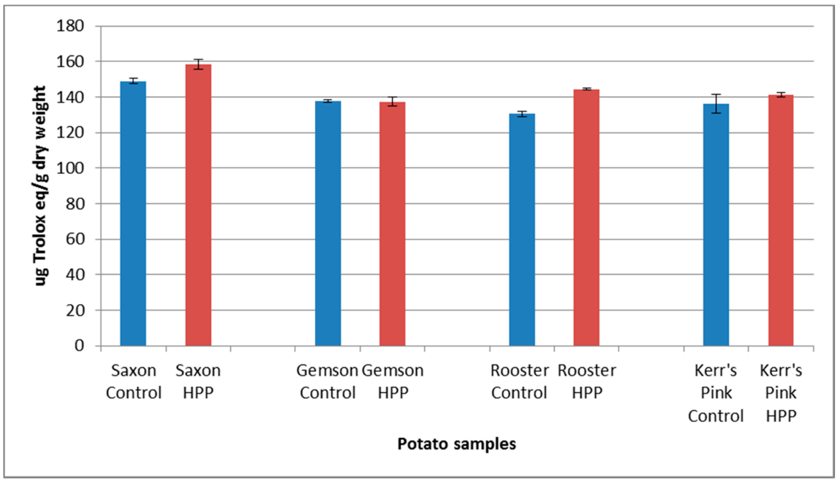

Figure 1. Effect of HPP treatment on antioxidant activity of potatoes as measured by FRAP assay and expressed as μg of Trolox equivalents per g of potato dry weight. Values presented are the average ± SD.

Figure 2 shows the effect of HPP treatment on the AOA of potatoes as measured by DPPH analysis. It can been seen that there were no statistically significant changes in AOA of HPP treated potato samples as compared to those untreated, in all cultivars.

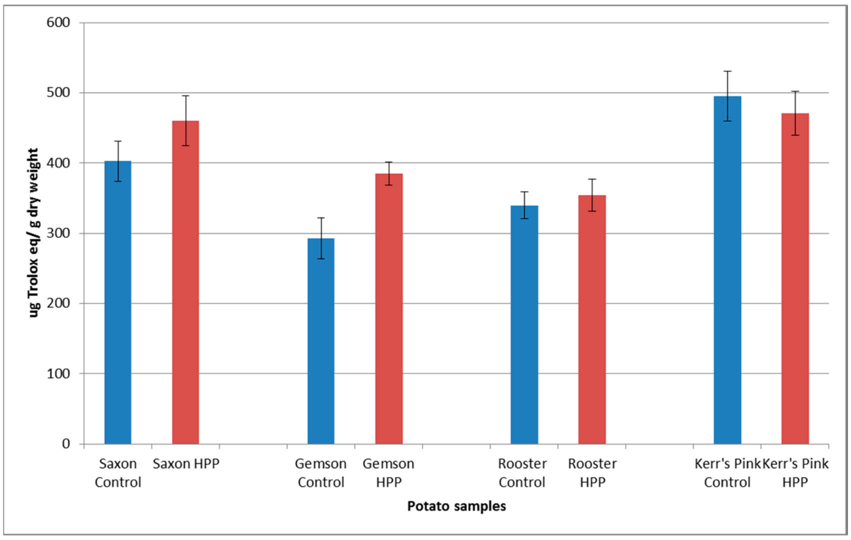

Figure 2. Effect of HPP treatment on antioxidant activity of potatoes as evaluated by DPPH assay expressed as μg of Trolox equivalents per g of potato dry weight. Values presented are the average ± SD.

A possible explanation of the contradicting results between FRAP and DPPH analysis could be that different antioxidant mechanisms are involved. For instance, FRAP is based on the ability of compounds to reduce ferric ion to ferrous ion whilst DPPH is a free-radical scavenging power. In the later scenario, depending on the radical-generating system, certain compounds might exert pro-oxidant activity [10]. In addition, antioxidant activity may be due to a combined effect of different compounds, acting either synergistically or antagonistically. A number of factors that influence the antioxidant activity such as oxidation system, degree of glycosylation, partition coefficient and concentration, which are not determined here have been reported [11].

4. Conclusions

High pressure processing overall did not have a statistically significant impact on the antioxidant activity of potatoes. However, HPP treated potatoes have shown improvement in quality and safety of the potatoes, which will be reported elsewhere. This study provides a scientific and technological basis to further develop HPP coupled chemistries for enhancing nutritional and functional qualities of potato cultivars.

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Conflicts of Interest: The authors declare no conflict of interest.

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