DEVELOPMENT OF BAKERY PRODUCT WITH SEA BUCKTHORN POMACE (*HIPPOPHAE RHAMNOIDES* L.)

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Abstract
In our modern world, avoid wasting or keep it at low level is important for the food industry too. After the fruits pressing stay a lot of pomace, which is rich in vitamins, antioxidant, and polyphenols. It has a few further usages, like pectin commodity or soil conditioners. After drying and grinding, it becomes seed meal.
In our experiment we try out the buckthorn (*Hippophae rhamnoides* L.) pomace further usage, in our case, we mixed with flour and baked cookie. We tested the level of polyphenol and antioxidants in the cookies. Furthermore, the whole polyphenol capacity (TPC), ferric reducing antioxidant power assay (FRAP) and the texture of biscuits have been tested.
The results are favorable in case of TPC and FRAP. The buckthorn pomace has a positive impact regard to substance.

Introduction
There more and more proof confirm the theory of the oxidative progress by radicals are contribute to arteriosclerosis, additionally, it was reported that antioxidant nutrients influence cell response and gene expression, which gives a new perspective to the mechanism of biological antioxidant activity [1-3]. Due to the modern way of life the consumption of the right quantity and quality antioxidant are essential to mitigate the harmful impact of radicals. In our busy world, there is increasing demand to fast food. As a result, the food industry tends to develop and produce such foods, which are good choice for health-conscious customer [4-6].
The sea buckthorn (*Hippophae rhamnoides* L.) is a rich source of antioxidant, polyunsaturated fatty acids, vitamins and minerals [7-10]. It is consumed in many forms in the food industry such as raw, syrup, canned, soda, jam and vitamin-rich processed concentrate. After squeezing the crop of sea buckthorn, the 75-85% of the weight of the berry is juice, other remaining after the press, like seed and peel in the most cases are used for forage or soil conditioner. However only a little percentage of total pomace mass is used in the food industry [11-14]. The sea buckthorn pomace in form of grist can be suitable for the mix with flour. While harvest the favorable physiological effect, it can be made a pleasant taste product. In today's world, the usage of the higher and higher rate of material became very important, while mitigating the weight of waste.
For this reason, the aim of our research is to successfully use the byproduct of buckthorn in the biscuits in order to make antioxidant-rich product.

Experimental
The „Ascola" sea buckthorn was collected from agricultural plots of Hungary in 2018. Chemicals were purchased from Sigma-Aldrich Chemie Ltd. All reagents used were of analytical grade.

Sea buckthorn was destemmed and then heated to 80°C, to inactivate enzymes. The material was squeezed, resulting in juice and pomace. Drying the pomace was the next step by an atmospheric dryer (LMIM, Hungary) at 80°C [15] until moisture content became lesser than 10%. After this step, the pomace was grinded.

In this experiment, three recipes were made with increasing sea buckthorn content (Fig. 1.)

	sugar (g)	coconut oil (g)	flour BL 55 (g)	sea buckthorn (g)	baking powder (g)	water (ml)
control	100	100	250	0	12	100
2.5% pomace	100	100	243.75	6,25	12	100
5% pomace	100	100	237.5	12.5	12	100

The biscuits were baked for the same time (10 min, 190°C).

Samples were stored at room temperature for 2 weeks in a sealed package, during which the following were examined at 3 sampling times:

- Water content was determined by drying until constant weight at 121 °C using a MAC-50 moisture analyzer (Radwag Waagen GMBH, Hilden, Germany).
- Various spectrophotometric measurements were carried out. All spectrophotometry measurements were performed in triplicate:
  - TPC: Total Polyphenol Content was evaluated using a method by Singleton and Rossi [16]. The absorbance was measured at 765 nm. Results were specified in mg Gallic acid equivalent/ 100 g biscuit (mg GAE/100g).
  - FRAP: The ferric reducing antioxidant power method of the samples was determined by Benzie and Strain [17]. The reduction is followed by the measurement of absorption change at 593 nm. FRAP value was defined in ascorbic acid equivalent (mg Ascorbic acid equivalent/ 100g biscuit; mg AA/100g).
- Texture was investigated by Brookfield, LFRA 4500 Texture Analyser. In the course of texture examination, hardness, adhesion, and elasticity were measured, because in the evaluation of the quality of biscuits these parameters are important aspects.

Results and discussion

Water content results during the two weeks storage period show on the Figure 1.

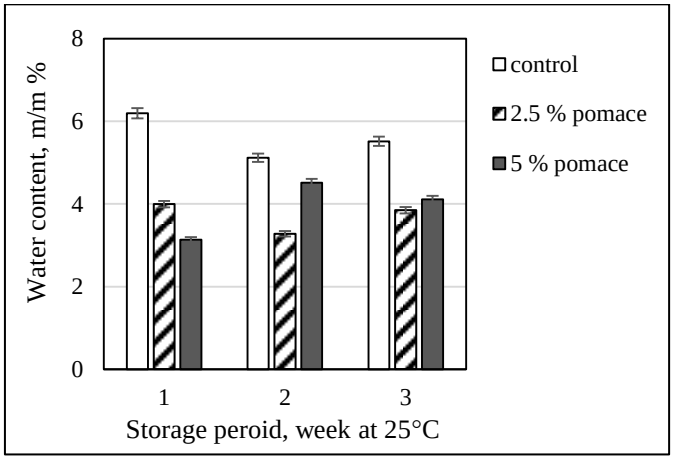

Figure 1. Water content of the biscuits during the storage period

At the beginning the control sample showed the highest level of water content, the 2.5 % pomace had lower and the 5% pomace had the lowest level of water content. After the one-week storage, the control and the 2.5 % pomace content sample had the same water content rate loss, while the water content of the 5% pomace was higher. In two weeks storage period,

water content of the 5% pomace showed a decrease and water content of the other two samples grew a little bit.

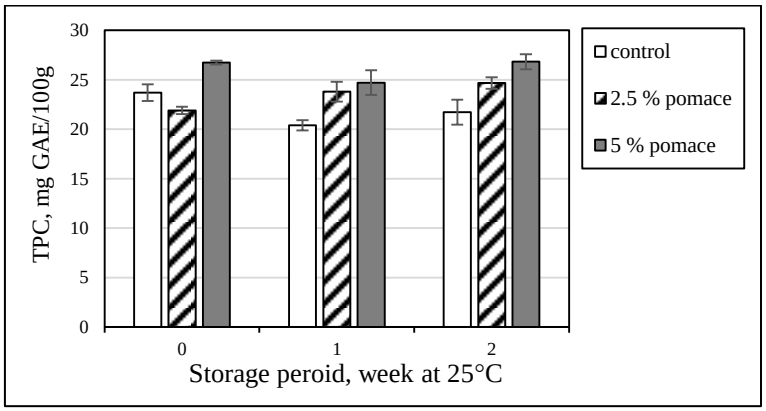

Figure 2. Results of total polyphenol content from biscuits during the storage period

The figure 2 shows the changes of total polyphenol content of biscuits during the storage period. At the first measurement, the 2.5% pomace sample had the lowest level of polyphenol out of the three sample (21.90 mg GAE/100g). In the case of control sample had a little higher value (23.70 mg GAE/100g), the 5% pomace sample had even higher value (26.75 mg GAE /100g). After one week the control sample had the lowest polyphenol content, the 5% pomace sample had a little higher value, while the 5% pomace sample had the highest measured value. At the next week, the measurement the ratio of the samples remained the same as before, but the values were raised a little bit.

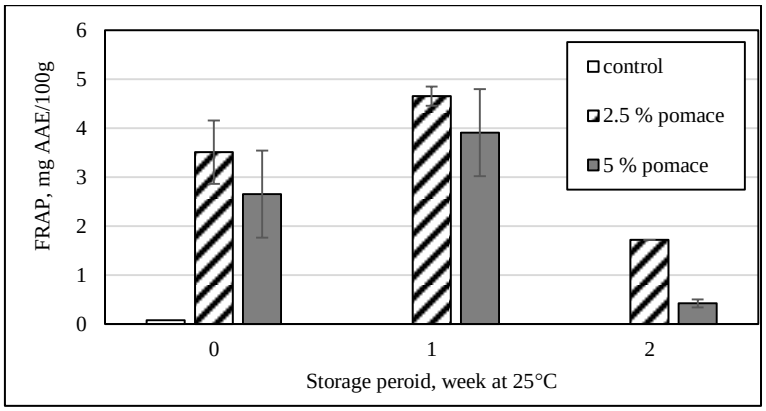

Figure 3. Results of antioxidant capacity (FRAP) from biscuits during the storage period

On the figure 3. the results of antioxidant capacity can see. The control sample barely contained antioxidants and those were completely decomposed during the weeks of storage. The initial sample, which contained 2.5% pomace, had the highest measured value (3,512mg AAE/100g), the 5% sample had less FRAP value (2,654mg AAE/100g). After one week storage, the antioxidant level was raised in both of the samples meanwhile there ratio stayed the same.

At the second week measurement, we experienced decreasing level in the 2.5% sample as well as in the 5% sample. Measured value of the 2.5% pomace sample was (1.720mg AAE/100g), while the 5% pomace had very low level FRAP (0.423mg AAE/100g).

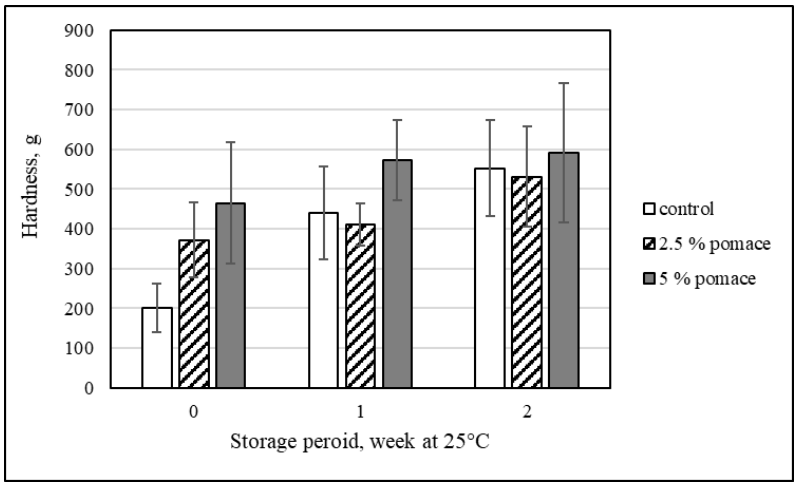

Figure 4. Hardness values of samples during the storage period

The results of texture examination are on the Figure 4.The hardness of the control sample had grown more during the storage, than the other two samples hardness. After one-week the value of hardness had double and after that, it continued to rise. In the beginning, we measured higher value in the case of 2.5% sample, unlike the control sample. A little growing could be observed after the first and second week. We measured double value in the 5% sample than in the beginning status of the control, the 2.5% sample had a little higher value as well. As the time moved forward, the hardness had grown a little bit of this sample.

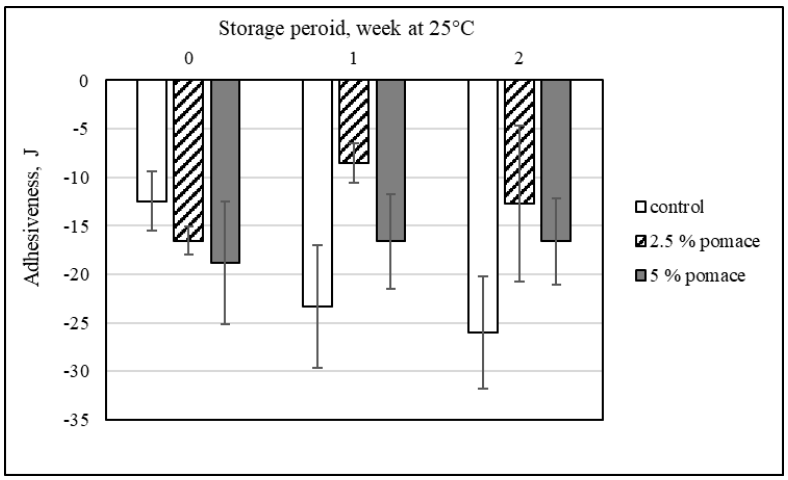

Figure 5. Adhesiveness values of sample during the storage period

The adhesion had decreased as the time has passed in the control sample. In the 2.5% pomace sample this value doubled after the first week and after the second week, it has started to decrease.

In the 2.5% pomace sample first got higher the adhesion level and after the second week, it has started to decrease. The adhesion level of 5% sample had moved just a little and mostly decreased a little.

Conclusion

One possible usage of the buckthorn pomace is to mix in products of the bakery.

Whit that the antioxidant content is enriching and this antioxidant level can be preserved at a high level during one-week store in 25°C as we observed in the research.

The polyphenol concentration of the cookies was almost the same after two weeks at 25°C.

For those who follow health-conscious nutrition, the favorable physiological effect from the buckthorn is available by the cookies. It easily could become an enjoyable but healthy everyday snack for families with children.

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