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Changes of Phenolics, Antioxidants constituents on wild Olive (*Elaeagnus latifolia* L.) fruit during syrup production

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Wild olive (*Elaeagnuslatifolia* L.) fruit is oblong in shape with a dark pink colour at ripening. This underutilized fruit contains abundant vitamins, minerals, essential fatty acids and bioactive phenolics beneficial to to combat the oxidative stress. This fruit is economically valuable due to its wide utilization of the fruit pulp. This research attempted to utilize the ripen wild olive (*Elaeagnuslatifolia* L.) fruit making for syrup. By focusing on the effect of different sugar alcohols (sucrose, maltitol, isomalt, sorbitol, xylitol), temperature and time (100/40, 105/35, 110/30, 115/25, 120/20, ^{o}C/min) in thermal concentration (evaporation) on the quality of wine olive syrup. Quality of fruit syrup was evaluated by total phenolic content, total flavonoid, ascorbic acid content, free radical scavenging activity (DPPH), ferric reducing antioxidant power (FRAP), overall acceptance. Results showed that the most phenolics, antioxidants constituents on wild olive (*Elaeagnuslatifolia* L.) fruit would be preserved effectively by maltitol (1.5/1.0, fruit/sugar), evaporation at 110/30 (^{o}C/min) during syrup making. This fruit would be processed into value-added syrup instead of raw consumption.

Keywords: Antioxidant, Elaeagnuslatifolia, evaporation, phenolic, sugar alcohol, syrup

INTRODUCTION

Wild olive (*Elaeagnuslatifolia* L.) is a thorny scandent shrub. It belongs to *Elaeagnaceae* family. Its fruit is green at young and dark pink/orange colour at maturity. This fruit is acidic in nature with titrable acidity value of 3.88±0.17 % and eaten as raw or cooked (Yamuna et al. 2018). It's also used for making chutney, jam, jelly, drink, fruit leather (Patel et al. 2008; Beatrice et al. 2020). It's a great source of vitamins and minerals, flavonoids and essential fatty acids (Indubhusan et al. 2018). These phytochemical and antioxidant constituents contributed to anticancer property (Souravet al. 2014). Method extract from this fruit had a promising effect on protecting pUC18 DNA (Chizzola et al. 2014; Panja et al. 2014). This wild fruit can be processed into functional foods to prevent and treat numerous chronic diseases (Yaet al. 2016). *Elaeagnuslatifolia* can be considered as a model system for agroforestry programs due to its ability in fixing atmospheric nitrogen and phosphorus intake capacity (Liza and Vipin, 2012).

Sugar alcohols possess weak acid properties (Ariana et al. 2020). Sugar alcohols were commonly used in food industry (Małgorzata, 2015). They would be excellent natural sweetener to reduce calorie and preserve palatability. Common sugar alcohols used in foods were sorbitol, maltitol, xylitol, erythritol, isomalt (Awuchi, 2017). Sugar alcohols were often received from hydrogenation of sugars. They possess no tooth decay, caramelization or high calorie intake (Bradshaw and Marsh, 1994). They release a remarkable cooling sensation in the mouth at high concentration (Cammenga et al. 1996). Generally, the sweetness of sugar alcohols was lower than saccharose. Therefore sugar alcohols could be used as bulk sweetener, texture, preservation, filling, moisture capture, and cooling effect in the mouth (Fitch and Keim, 2012). Objective of our study was to verify the effect of different sugar alcohols (sucrose, maltitol, isomalt, sorbitol, xylitol), temperature and time (100/40, 105/35, 110/30, 115/25, 120/20, ºC/min) in thermal concentration (evaporation) on the quality of wine olive syrup.

MATERIALS AND METHODS

2.1 Material

Wild olive (*Elaeagnuslatifolia* L.) fruits were collected from supermarket. They were subjected to washing, mashing and concentration. Sugar alcohols (sucrose, maltitol, isomalt, sorbitol, xylitol) were all food grade.

2.2 Researching method

Wild olive (*Elaeagnuslatifolia* L.) fruits were set layer by layer with different sugar alcohols (sucrose, maltitol, isomalt, sorbitol, xylitol) in glass jar at the same ratio (1.5/1.0, fruit/sugar). Maceration was last for 12 hours. These samples were evaporated in different conditions: 100/40, 105/35, 110/30, 115/25, 120/20, (ºC/min). The syrup was filled in clean glass bottle ready for chemical and sensory analysis. Total phenolic content (TPC, mg GAE/100 g) was examined by Folin-Ciocalteu reagent assay (Cristina et al. 2015). Aluminum chloride colorimetric method was used for flavonoids (mg QE/100 g) quantification (Mandal et al. 2013). Ascorbic acid content (mg/100g) was determined as per standard method using 2, 6- dichlorophenol indophenol dye (Ranganna, 1986). Free radical scavenging activity **(**DPPH, %) was evaluated by method described by Bakar et al. (2017). Ferric reducing antioxidant power **(**FRAP, µg/g) assay was performed by procedure of Benzie and Strain (1996). Overall acceptance was evaluated as sensory score by a group of panelists using 9 point-Hedonic scale.

2.3 Statistical analysis

The experiments were run in triplicate with different groups of samples. The data were presented as mean±standard deviation. Statistical analysis was performed by the Statgraphics Centurion version XVI.

RESULTSAND DISCUSSION

The effect of different sugar alcohols (sucrose, maltitol, isomalt, sorbitol, xylitol) on total phenolic content, total flavonoid, ascorbic acid content, free radical scavenging activity (DPPH), ferric reducing antioxidant power (FRAP), overall acceptance of the wild olive syrup was clearly presented in table 1. Maltitol revealed the best option among sugar alcohols. Maltitol, a sugar alcohol, is a hygroscopic non-reducing sugar originated from maltose as a bulk sweetener. Maltitol has a low glycaemic index (Ariana et al. 2020). Maltitol is poorly absorbed in the small intestine (Livesey, 2003). Maltitol is commonly used in bakery, dairy product, chocolate and sweet to enhance its textural and sensory characteristics and enhances their storage stability due to anti-blooming effect (Son et al. 2018). Sorbitol had good compressibility and commonly utilized as a bulking agent (Michael and Roland, 2013). Isomalt derived from sugar by fermentation of sucrose to isomaltulose and further hydrogenation of the reducing fructose moiety. Isomalt exhibited about half the sweetness of sucrose. Xylitol was prepared from hydrolyzation of xylan into xylose which was catalytically hydrogenated into xylitol. Xylitol had sweetness as sucrose and gave an excellent cooling effect (Nguyen, 2020). Phenolics are essential phytochemical components as their capacity to confer free radical scavenging (Yildirimet al. 2000). Flavonoids express their antioxidant potentials via scavenging reactions (Kessler et al. 2003). Ascorbic acid is also an important antioxidant phyto constituent.

Thermal treatment caused soften the plant tissue and weaken the phenol-protein and phenol-polysaccharide interactions (Mokrani et al. 2016). Ascorbic acid content was decreased with increase in evaporation time which might have been due to the oxidation of antioxidants at long duration (Ashwani et al. 2017). A significant amount of total soluble solid was noticed in *Elaeagnuslatifolia* (13.2±0.2 ºBrix). The maximum titrable acidity was observed in *Elaeagnuslatifolia* (3.88±0.17 %). Meanwhile, ascorbic acid was found 14.13±1.50 mg/100g in this fruit (Yamuna et al. 2018). Sherpa and Bhutia (2020) proved that thermal processing of *Elaeagnuslatifolia* fruit led to statistical significant modification of phytochemical variables such as total antioxidant, ascorbic acid, total phenol, total flavonoids, total anthocyanin and total carotenoids.

Table 1: Effect of different sugar alcohols (sucrose, maltitol, isomalt, sorbitol, xylitol) on total phenolic content, total flavonoid, ascorbic acid content, free radical scavenging activity (DPPH), ferric reducing antioxidant power (FRAP), overall acceptance of the wild olive syrup

Sugar alcohol	Sucrose	Isomalt	Maltitol	Sorbitol	Xylitol
Total phenolic (mg GAE/g)	55.21 ± 0.05^{c}	56.38 ± 0.03^{b}	57.02 ± 0.01^{a}	56.75 ± 0.02^{ab}	55.89 ± 0.02^{bc}
Total flavonoid (mg QE/g)	28.74 ± 0.03^{c}	31.71 ± 0.02^{b}	35.29 ± 0.04^{a}	33.02 ± 0.00^{ab}	30.55 ± 0.05^{bc}
Ascorbic acid (mg/100g)	6.85 ± 0.04^{c}	7.64 ± 0.01^{b}	8.42 ± 0.00^{a}	8.03 ± 0.03^{ab}	7.09 ± 0.01^{bc}
DPPH (%)	30.41 ± 0.05^{c}	37.64 ± 0.02^{b}	43.19 ± 0.04^{a}	40.53 ± 0.02^{ab}	33.68 ± 0.04^{bc}
FRAP (µg/g)	8.12 ± 0.02^{c}	9.27 ± 0.03^{b}	10.78 ± 0.06^{a}	10.02 ± 0.01^{ab}	8.96 ± 0.00^{bc}
Overall acceptance	5.69 ± 0.01^{c}	6.74 ± 0.07^{b}	7.87 ± 0.03^{a}	7.15 ± 0.04^{ab}	6.20 ± 0.03^{bc}

Note: the values were expressed as the mean of twenty two samples; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2:Effect of temperature and time in condensation on total phenolic content, total flavonoid, ascorbic acid content, free radical scavenging activity (DPPH), ferric reducing antioxidant power (FRAP), overall acceptance of the wild olive syrup

Condensation (ºC/min)	100/40	105/35	110/30	115/25	120/20
Total phenolic (mg GAE/g)	57.02 ± 0.01^{c}	58.25 ± 0.07^{b}	59.43 ± 0.03^{a}	58.97 ± 0.02^{ab}	57.86 ± 0.04^{bc}
Total flavonoid (mg QE/g)	35.29 ± 0.04^{c}	36.67 ± 0.04^{b}	37.59 ± 0.02^{a}	37.01 ± 0.01^{ab}	35.91 ± 0.03^{bc}
Ascorbic acid (mg/100g)	8.42 ± 0.00^{c}	9.40 ± 0.03^{b}	10.62 ± 0.01^{a}	9.93 ± 0.03^{ab}	8.93 ± 0.00^{bc}
DPPH (%)	43.19 ± 0.04^{c}	44.02 ± 0.01^{b}	45.03 ± 0.04^{a}	44.61 ± 0.00^{ab}	43.75 ± 0.02^{bc}
FRAP (µg/g)	10.78 ± 0.06^{c}	11.89 ± 0.06^{b}	12.77 ± 0.02^{a}	12.34 ± 0.05^{ab}	11.34 ± 0.01^{bc}
Overall acceptance	7.87 ± 0.03^{c}	8.31 ± 0.02^{b}	8.79 ± 0.00^{a}	8.52 ± 0.06^{ab}	8.03 ± 0.04^{bc}

Note: the values were expressed as the mean of twenty two samples; the same characters (denoted above), the difference between them was not significant (α = 5%).

Phytochemical contents in *Elaeagnuslatifolia*were found in ripen fruit with total antioxidant 15.92±0.82 µg/ml, ascorbic acid 9.93±0.83 mg/100g, total phenol 27.90±0.51 mgGAE/g, total flavonoids 22.72±0.28 mg QE/g, total carotenoids 3.27±0.06 mg/100g, total anthocyanin 1.26±0.16 mg/100g. These phytochemical contents in *Elaeagnuslatifolia* were changed in processed products: chutney (total antioxidant 8.61±0.07µg/ml, ascorbic acid 5.88±0.67mg/100g, total phenol 19.07±0.34 mgGAE/g, total flavonoids 15.73±0.01mg QE/g, total carotenoids 2.84±0.06 mg/100g, total anthocyanin 0.31±0.01mg/100g), ketchup (total antioxidant 10.16±0.02 µg/ml, ascorbic acid 7.54±0.43 mg/100g, total phenol 21.55±0.57 mgGAE/g, total flavonoids 16.42±0.0 mg QE/g, total carotenoids 2.96±0.005 mg/100g, total anthocyanin 0.36±0.005 mg/100g).

CONCLUSION

Elaeagnuslatifolia L. fruit contains rich phytochemicals with different bioactive effects. This fruit is not preferred in fresh form due to its taste and acidic nature. In this research, we have successfully examined the effect of different sugar alcohols, temperature and time in thermal concentration on the quality of wine olive syrup. Maltitol should be a good alternative to sucrose. This crop can make people much more healthy and nutrition if it's exploited properly.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Nguyen Phuoc Minh arranged the experiments and also wrote the manuscript.

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