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Degradation kinetics of anthocyanin, flavonoid, and total phenol in bignay (*Antidesma bunius*) fruit juice during ohmic heating

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Abstract

The effect of ohmic heating on bioactive compounds in bignay (*Antidesma bunius*) fruit juice during ohmic heating were evaluated. The parameters measured were total phenol, anthocyanin, flavonoid, and antioxidant activity. Ohmic heating was conducted at 70, 90, and 110 °C, and samples were collected at heating times of 0, 15, 30, and 45 minutes. Electrical conductivity of bignay fruit juice increased linearly with temperature with values ranged from 0.012 S/m at 32 °C to 0.039 S/m at 110 °C. Insignificant change in total phenol was observed, while anthocyanin and flavonoid showed significant degradation and the degradation kinetics followed the first-order kinetic model. The degradation rate constants for anthocyanin ranged from 0.0016 to 0.0213 min^{-1} with activation energy (E_a) of 63.880 kJ/mol and the degradation rate constants for flavonoid were in the range of 0.0107 to 0.0209 min^{-1} with activation energy of 18.210 kJ/mol. Antioxidant activities (IC_{50}) obtained from DPPH method ranged from 0.106-0.168 mg/mL while those obtained from ABTS method ranged from 0.131-0.161 mg/mL. The results indicate that anthocyanin and total phenol in bignay fruit juice is much more stable during heating compared to flavonoid.

Keywords: bignay fruit juice; ohmic heating; bioactive compounds; antioxidant activity.

Practical Application: Production of antioxidant rich bignay fruit juice using ohmic heating technology.

1 Introduction

During the past decade, fruit juice has gained remarkable interests in beverage market sector. Processing of fruits into juices has been a commercial way to diversify the usage of the fruits and to fulfill demands beyond harvest season. In addition, fruit juice has been viewed as a more convenient way to obtain comparable health benefits from the fruits to those from direct consumption. As the markets for fruit juice are approaching saturation, however, competitions among industries to attract consumers with their juice products are escalating. This condition requires industries to constantly innovate and introduce new products to the market. One approach that the beverage industry can use to win the competition is by introducing exotic fruit juice to the market.

Exotic fruits from tropical countries such as bignay (*Antidesma bunius*), Indian black plum or jamun (*Syzygium cumini* L), red mulberry (*Morus rubra* L.), and black mulberry (*Morus nigra* L.) have gained interests from researchers for their potential as sources of bioactive compounds and natural antioxidants. Studies on bignay fruits (Butkhup & Samappito, 2008; Hardinasinta et al., 2020; Jorjong et al., 2015; Lim, 2012; Ngamlerst et al., 2019), black plum (Aqil et al., 2012; Banerjee et al., 2005; Singh et al., 2018), and mulberry (Isabelle et al., 2008; Kim et al., 2010; Zhang et al., 2008) indicate that these fruits are rich in phenolic compounds such as flavonoids and athocyanins which have the potential to provide health benefits as reported by numerous authors (Aiyer et al., 2008; Basli et al., 2017; Chowtivannakul et al., 2016; Mazza, 2007; Ngamlerst et al., 2019; Stoner et al., 2007; Timmers et al., 2015; Wang & Stoner, 2008). Bignay fruit is an exotic fruit which is mostly found in Southeast Asian countries such as Thailand and Indonesia. This fruit resembles berries with a purplish-black color and a sweet-sour taste when fully ripe. In addition, due to its chemical contents, this fruit can be used as a raw material for production of antioxidant-rich beverages (Chaikham et al., 2016; Sripakdee et al., 2015).

In production of drinks and beverages, microbial safety of the products is of paramount importance. This is usually achieved through thermal treatments such as pasteurization and sterilization or non-thermal treatments such as pulsed electric field processing and high-pressure processing. One of the negative impacts of heat treatments of foods is the degradation of quality attributes such as nutrient contents, texture, color, and bioactive compounds. To minimize these effects, thermal technologies which can provide rapid and uniform heating such as ohmic and microwave heating technologies and non-thermal technologies have been developed. In the case of ohmic heating, rapid and uniform heating have been shown both experimentally and through mathematical simulations (Cokgezme & Icier, 2019; Icier & Ilicali, 2005; Kaur et al., 2016; Lascorz et al., 2016; Petruzzi et al., 2017; Priyadarshini et al., 2019; Qihua et al., 1993; Salengke & Sastry, 2007a, b; Sastry & Salengke, 1998; Varghese et al., 2014).

The use of ohmic technology in heating and processing of various types of solid and liquid foods has been studied extensively (Abedelmaks et al., 2018; Achir et al., 2016; Athmaselvi et al., 2017; Cappato et al., 2018a,b; Castro et al., 2004; Cokgezme & Icier, 2019; Darvishi et al., 2011, 2013; Farahnaky et al., 2012; Fattahi & Zamindar, 2020; Icier et al., 2017; Lascorz et al., 2016;

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