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Possibility of Saccharose Replacement by Sugar Alcohols on Firmness, Spreadability and Acceptability of Soursop (*Annona muricata*) Jam

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Consumer preferred to low-calorie jam for health benefit. Sugar alcohols could be considered as promising alternative for jam making. Sugar alcohols didn't contribute to tooth decay and high energy intake. Soursop had excellent antioxidants and nutrients beneficial for health benefits. However it's sensitive to microbial, enzymatic, chemical and physical deterioration. Sugar alcohols had been well known in tooth friendliness, low energy value and potential benefits. This research evaluated the possibility of sugar alcohols (mannitol, sorbitol, xylitol, erythritol and isomalt) replacement to saccharose in jam preparation from soursop fruit. Firmness (g), spreadability (g/sec), acceptability (sensory score) were evaluated on jam. Results showed that 20% isomalt replacement to saccharose was adequate to obtain high quality soursop jam to satisfy consumer demand for healthy food.

Keywords: Acceptability, firmness, replacement, soursop jam, spreadability, sugar alcohol

INTRODUCTION

Jam was one of the most efficient strategies to preserve fruit for long-term consumption during the off-seasons. The common ingredients in jam preparation included fresh fruit, sugar, gelling agent and acidic agent boiling to a reasonably thick gel consistency, firm enough to hold the fruit tissues in position (Ho et al., 2020). Saccharose was normally added into jam for sweet taste and a natural preservative in inhibition of microbial proliferation under low water activity condition in the jam (Alsuhaibani and Al-kuraieef, 2018). However over usage of saccharose was normally associated with high energy intake inducing to higher risks for obesity, diabetes, and cardiovascular diseases (Ho et al., 2020). Therefore consumers required jam having low calorie, high protein and dietary fibre (Abdullah and Cheng, 2001; Mamede et al., 2013; Amin et al., 2016). Sugar alcohols were widely utilized in food, beverage, confectionery and pharmaceutical industries (Małgorzata, 2015). Sugar alcohols could be considered as excellent source of natural sweetener to limit calorie and maintain palatability. The sugar alcohols commonly found in foods were sorbitol, mannitol, xylitol, erythritol, isomalt, and hydrogenated starch hydrolysates (Awuchi, 2017). They were normally obtained by hydrogenation of sugars. They contributed to neither tooth decay, caramelization nor high calorie intake (Bradshaw and Marsh, 1994). They could produce a noticeable cooling sensation in the mouth when highly concentrated (Cammenga et al., 1996). The sweetness of sugar alcohols was lower than saccharose. Thus sugar alcohols might be used as bulk sweetener, texture, preservation, filling, moisture capture, and cooling effect in the mouth (Fitch and Keim, 2012).

Mannitol was originated from starch through the reaction of catalytic hydrogenation of maltose (Dobreva et al., 2013). Its identical properties such as odourless, white crystalline appearance

and texture were similar to saccharose. It reduced the crystallization tendency with low hygroscopicity of sugars and extended the shelf life of food commodities. It was commonly utilized in medication as a sweetener in diabetic food. It's very useful as edible coating for hard candies, dried fruits, and chewing gums to create pleasant sweet taste and mouthfeel. It exhibited the reduced physiological calorie value compared to saccharose . It's partially absorbed and metabolized by the body therefore contributing to lower calorie and a lesser effect on blood glucose level than other sugars (Ho et al. 2020). Sorbitol was obtained by reduction of glucose, changing the aldehyde group to a hydroxyl group. It's often utilized in diet food, mouthwash and toothpaste. Moreover, it's also used as a cryoprotectant additive in surimi and fish paste, sweetener and humectant in cookies. Xylitol was nonfermentable sugar alcohol actively beneficial for dental health by reducing cavity. In the human gut xylitol was not absorbed. Erythritol was free from side effects, tooth-friendly, much more difficult for intestinal bacteria to digest. Due to its hygroscopic property, it's highly prefered in baked products, chewing gums, candy products, ice creams and also ipocaloric beverages (Małgorzata, 2015). Isomalt was the only bulk sugar replacer made exclusively from saccharose. It's originated from a two-step production process, including enzymatic conversion and hydrogenation process. By its excellent physiological properties like sugar-free, calorie-reduced, tooth-friendly, it's commonly applied on high-quality commodities such as chocolate, baked goods and cereal products to serve consumer demand for good tasting healthier products with a long stability (Tom et al., 2020).

Soursop (*Annonamuricata)* was one of the exotic fruits highly evaluated due to its phytochemical constituents with unique pleasant, sub-acid, aromatic and juicy flesh juice. It contained numerous valuable antioxidants and nutrients such as amino acids, ascorbic acid, calcium, carbohydrates, iron, phosphorus, thiamine, fibres, riboflavin (Amusa et al. 2003; Abbo et al. 2006). There were different therapeutic properties derived from this fruit such as diuretic, antiurethritis, antihaematuria, antiantibacterial, anticancerous, astringent, antihypertension, sedative, and anti-aging (Eka et al., 2012; Elavarasan et al.2014; Kumar et al. 2015; Puran et al. 2015; Arif and Moch, 2016; Mithunet al. 2016; Prasetyorini and Moerfiah, 2016; Sejal and Jayvadan, 2016; Evy et al., 2017; Khairunet al. 2017; Liliet al. 2017; Uno et al.2017; Banerjee et al., 2018; Islam et al., 2018) It's commonly discarded at market because of its external injury, or uneven shape and size (Umme et al. 2001). It became mushy and decayed rapidly during ripening and and difficult to consume fresh fruit (Nguyen et al. 2019). It should be processed into various forms such as the puree, juice, jam and jellies for extended shelf life (Ajayi et al. 2015). Objective of our study evaluated the possibility of sugar alcohols (mannitol, sorbitol, xylitol, erythritol and isomalt) replacement to saccharose in jam preparation from soursop fruit.

MATERIALS AND METHODS

2.1 Material

Ripen soursop fruits were collected in Nga Nam district, SocTrang province, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be washed thoroughly under turbulent washing to remove dirt, dust and adhered unwanted material. Besides soursop fruits, other materials such as were also used mannitol, sorbitol, xylitol, erythritol and isomalt.

2.2 Researching method

The fruits were peeled and removed seeds to get white pulp. Fruit pulp was cut into cube size and blended thoroughly by blender to obtain fruit puree. The jam formulation was prepared by adding 20% saccharose (as control), the same amount of mannitol, sorbitol, xylitol, erythritol and isomalt as saccharose replacement into fruit puree.These mixtures were boiled vigorously for about 30 minutes until reaching the desired viscosity. The jam was hot-filled into sterilized glass jars ready for physical and sensory evaluation.

2.3 Firmness, spreadability and sensory evaluation

Firmness (g) wasevaluated by the force required to compress a food product between the molar teeth (Anuar and Salleh, 2019).Spreadability (g/sec) was determined by texture analyzer. Overall acceptance (sensory score) was evaluated by a group of panelists using 9 point-Hedonic scale.

2.4 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

Sugar had a key role injam making to produce acceptablephysical, chemical, and sensorial properties. Saccharose was often added to bind water inducing pectin gelatinization, reducing the water activity, inhibiting microbial growth and subsequent deterioration of jams (Basu and Shivhare, 2010). Texture of jam had to provide a balance between desired mechanical stability and desired instability (Basu et al., 2011). Jam supplemented by isomalt showed the lowest firmness value (268.43 g) compared to other sugar alcohols (328.17÷505.74 g) and control (611.62 g) (figure 1). A similar trend was noticed for the spreadability indicator, jam supplemented by isomalt had significantly lower spreadability value (211.05 g/s) than the others (223.45÷403.69 g/s) (figure 2). Our results were parallel to finding by Ho et al. (2020) in processing belimbi fruit (*Averrhoabelimbi*) jam with maltitol. Firmness was strongly correlated with the spreadability indicator of jam. The higher the firmness value, the higher the force necessary to spread jam (Tifani et al. 2018). Firmness and spreadability were significantly affected by acidity, pectin, and type of sugar during jam making (Mamede et al. 2013; Tifani et al. 2018).

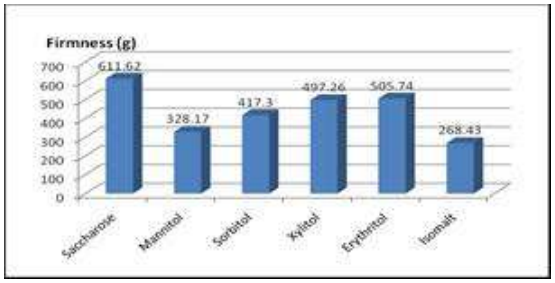

Figure 1:Effect of saccharose replacement by sugar alcohols on firmness (g) of soursop jam

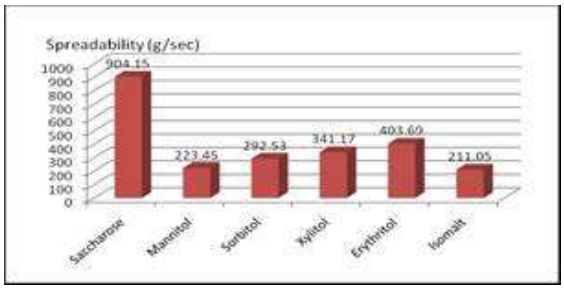

Figure 2:Effect of saccharose replacement by sugar alcohols on spreadability (g/sec) of soursop jam

In overall acceptable evaluation, the jam prepared with mannitol or isomalt had the highest sensory score (8.34 or 8.76, respectively) (figure 3). Our results were in agreement with finding by Anuar and Salleh (2019) in fruit jam making from *Averrhoabilimbi* L. Basu et al. (2011) examined rheological, textural and spectral characteristics of sorbitol substituted mango jam. Mango jam manufactured with sucrose/sorbitol had a weak gel because of weaker junction zones in pectin gel network. Hydrogen bonding and hydrophobic interactions created pectin polymeric chain network formation in fruit jam. Alice et al. (2015) developed strawberry, raspberry, and cherry jams with sorbitol as sucrose replacement. It's demonstrated to be potential low glycemic index, reduced calories.Sung-Jin et al. (2015) demonstrated the impact of replacing sucrose with sugar alcohols (sorbitol, glycerol and xylitol) on the quality characteristics of semi-dried jerky. Replacing sucrose with 5.0% xylitol revealed the lowest shear force. 5.0% xylitol treatment was found to be significantly different in the overall acceptance.

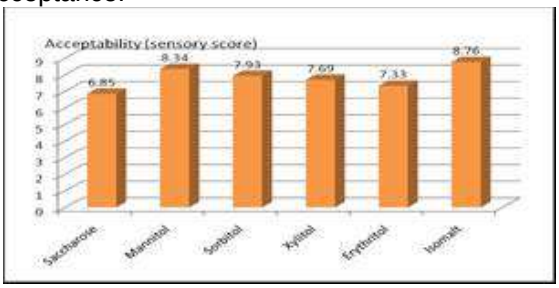

Figure 3: Effect of saccharose replacement by sugar alcohols on overall acceptance of soursop jam

CONCLUSION

Soursop was rich in natural antioxidants, dietary fibers, vitamins, minerals essential for health benefits. Its high perishability and the lack of appropriate techniques for postharvest, transport and storage resulted in great losses. Processing soursop fruit into jam would be an excellent alternative to extend significantly its shelf-life for long lasting consumption. High saccharose content in jam caused adverse effects on health. Therefore sucrose replacement by sweetners was very necessary to satisfy customer demand in healthy, innovative and safe manner. This research investigated the possibility of different sugar alcohols to replace sucrose in jam making from soursop fruit. Isomalt and mannitol might be the best candidates for sucrose replacment in respect of textural characteristics

and sensorial profile.

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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