Food Research International 100 (2017) 235–240

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Changes in anthocyanins and volatile components of purple sweet potato fermented alcoholic beverage during aging

Suhong Li[a], Yingfeng An[b,1], Weina Fu[a], Xiao Sun[c], Wenjie Li[c], Tuoping Li[a,*]

[a] College of Food Science, Shenyang Agricultural University, Shenyang 110866, China
[b] College of Biological Science and Technology, Shenyang Agricultural University, Shenyang 110866, China
[c] Shenyang Women's and Children's Hospital, Shenyang 110011, China

ARTICLE INFO

Chemical compounds studied in this article:
Cyanidin-3-*O*-glucoside(PubChem CID: 441667)
Cyanidin-3-sophoroside-5-glucoside (PubChem CID: 44256732)
Peonidin-3-sophoroside-5-glucoside (PubChem CID: 44256845)
1-Pentanol (PubChem CID: 6276)
Phenylethyl alcohol (PubChem CID: 6054)
Formic acid (PubChem CID: 284)
3-Octanol (PubChem CID: 11527)
4-Hydroxy-3-Methoxycinnamic acid (PubChem CID: 445858)
2-Methoxy-4-vinylphenol (PubChem CID: 332)

Keywords:
Anthocyanin
Volatile component
Purple sweet potato
Alcoholic beverage
Aging

ABSTRACT

Purple sweet potato was fermented into alcoholic beverage. By using LC-MS analysis, 12 types of anthocyanins were found in the purple sweet potato alcoholic beverage (PSPFAB); these were based on cyanidin and peonidin as aglycones. The anthocyanins in young PSPFAB mainly consisted of acylates. The acylated anthocyanins, however, degraded gradually with aging. Cyanidin 3-sophoroside-5-glucoside and peonidin 3-sophoroside-5-glucoside were found to be major anthocyanins in the PSPFAB after two years of aging. Moreover, 52 kinds of volatile components were detected in PSPFAB by GC–MS analysis. Alcohol and ester substances constituted a major proportion of these volatile components of PSPFAB. After two years of aging, levels of high-alcohols such as 1-pentanol remarkably decreased to below the detection limit, while the level of total esters increased significantly. Such variation of aromas enriched and improved the flavor of PSPFAB.

1. Introduction

The purple sweet potato, a highly nutritious vegetable, contains high amounts of anthocyanin pigment, which is bright in color, non-toxic, and soluble in water (Li et al., 2012). However, the stability of anthocyanin can be affected by various physicochemical factors, including oxygen, light, temperature and pH etc. (Cavalcanti, Santos, & Meireles, 2011). Anthocyanins also have certain nutritional and pharmacological effects such as antioxidant (Furuta, Suda, Nishiba, & Yamakawa, 1998), anti-inflammatory (Suda, Furuta, & Nishiba, 1997), anti-mutation (Yoshimoto, Okuno, Yamaguchi, & Yamakawa, 2001), anti-tumor (Lim et al., 2013) properties and aid in the prevention and treatment of cardiovascular diseases (Park, Kim, Lee, Lee, & Cho, 2010). Further, it has many potential applications in food, cosmetic, and pharmaceutical industries. In addition to anthocyanins, purple sweet potato is also rich in vitamins (B1, B2, C and E), minerals (Ca, Mg, K, Zn and Se), dietary fiber, and dietary carbohydrates (Ishida et al., 2000). Currently, the deep processing products of purple sweet potato are mainly focused on the pigments and starches. However, there are relatively few studies on the fermentation products of purple sweet potato. Previously, we have successfully developed the technology for processing of the purple sweet potato fermented alcoholic beverage (PSPFAB), which presents great taste and function (Fu et al., 2012).

It has been reported that the anthocyanins in purple-fleshed sweet potato primarily occur as acylated compounds (Truong, Nigel, Thompson, & Dean, 2010). Until date, 22 anthocyanins have been found from several purple sweet potato cultivars, which are acylated by *p*-hydroxybenzoic acid, caffeic acid, ferulic acid, and *p*-coumaric acid, based on cyanidin, peonidin, and pelargonidin (Konczak-Islam, Okuno,

* Corresponding author.
E-mail address: Ltp0401@126.com (T. Li).
[1] Co-first author.

http://dx.doi.org/10.1016/j.foodres.2017.08.041
Received 16 May 2017; Received in revised form 16 August 2017; Accepted 18 August 2017
Available online 19 August 2017
0963-9969/

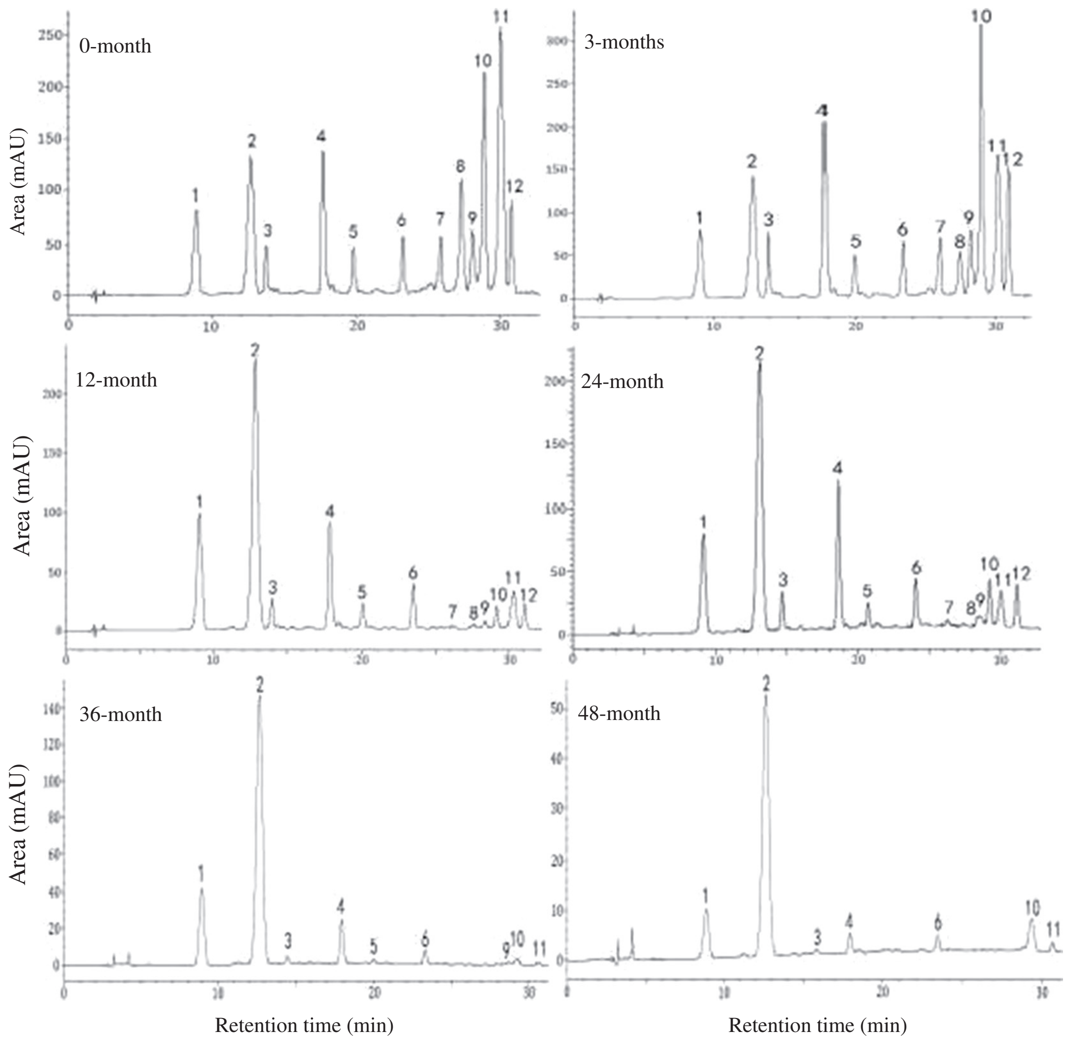

Fig. 1. HPLC chromatograms of PSPFAB anthocyanins. The peak numbers represented anthocyanin compounds, in accordance with those shown in Table 1.

Yoshimoto, & Yamakawa, 2003; Tian, Konczak, & Schwartz, 2005). However, little is known about the quantitative and structural variation of anthocyanins in purple sweet potato wine during its aging.

In many cases, wine production includes aging process. During the aging period, several physicochemical reactions such as esterification, hydrolysis, redox reactions, spontaneous clarification, CO_2 elimination, and slow and continuous diffusion of oxygen, occurred, leading wine to improve its sensory and aromatic characteristics (Liberatore, Pati, Nobile, & Notte, 2010). The aging process also directly affects the taste of wine.

In this study, the changes in pigments and volatile components of PSPFAB during the aging process were investigated, in order to provide the basic data for improving the edible quality of PSPFAB.

2. Materials and methods

2.1. Materials

Zishuwang cultivar of purple sweet potato (*Ipomoea batatas*) was cultivated in May 1, 2010, and was harvested in Oct. 20, 2010, in Liaoyang farm, China. After pre-processing of stewing, crushing and enzymolysis, the purple sweet potato was fermented at 18 °C with commercial fruit wine yeast (Anqi, China) inoculum of 1.6×10^7 cfu/mL for 18 days. The pH of newly brewed PSPFAB was 3.87 and ethyl alcohol content was 11.05% (v/v). After clarification process, the PSPFAB was then packed in 500 mL glass bottle and aged at 10 °C for 4 years.

2.2. Qualitative and quantitative analysis of anthocyanins in PSPFAB

Anthocyanins of PSPFAB were identified by LC-MS (1100 HPLC/MSD Trap-VL, Agilent, USA). The MS parameters were as follows: ESI (+), 100–1500 *m/z* in full scan mode, drying gas flow of 12 L/min, and temperature 300 °C, nebulizer pressure 30 psi, Vcap 3500 V, fragmentor voltage, 135 V.

The contents of PSPFAB anthocyanins were quantified by high performance liquid chromatography (HPLC) using an Agilent 1200 HPLC system (Agilent, USA). A Zorbax Eclipse SB-C18 column (4.6 mm × 250 mm, 5 μm particle size, USA) was used for the separation at 30 °C. The mobile phases were 7.5% formic acid in water (phase A) and 7.5% formic acid in methanol (phase B). Sample was eluted gradually with phase A and B at the gradient conditions of 10% phase B up to 45% phase B in 40 min. The flow rate was 0.8 mL/min. Sample was scanned from 190 to 600 nm. Anthocyanin was quantified by the area measurement at 525 nm. Cyanidin-3-*O*-glucoside was used as a standard. The content of anthocyanin was calculated by a standard calibration curve with a linear correlation coefficient of 0.991.

2.3. Determination and quantification of volatile components in PSPFAB

Volatile components in PSPFAB were extracted using dichloromethane, and then subjected to gas chromatography mass