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Cranberry Fruit Juice Concentrate

Change to read:

DEFINITION

Cranberry Fruit Juice Concentrate consists of a bright red juice derived from the ripe fruits of *Vaccinium macrocarpon* Aiton (Fam. Ericaceae), concentrated to a content of soluble solids corresponding to a refractive index of 1.4191–1.4212. It contains NLT 0.6% w/w of total proanthocyanidins, calculated as procyanidin A2 ($C_{30}H_{24}O_{12}$). ▲ It contains NLT 6.0% each of quinic acid and citric acid, and NLT 4.0% of malic acid; the ratio of quinic acid to malic acid is NLT 1.0. ▲ (USP 1-May-2024) It contains no added substances.

IDENTIFICATION

• A. HPLC PROFILE OF ORGANIC ACIDS

Analysis: Proceed as directed in the test for *Content of Organic Acids*.

Acceptance criteria: The *Sample solution* exhibits peaks in increasing retention time due to quinic acid, malic acid, and citric acid corresponding to the retention times of the same constituents in *Standard solution A*. The *Sample solution* also exhibits a small peak eluting before quinic acid corresponding to galacturonic acid, and an intense peak eluting after malic acid corresponding to shikimic acid and ascorbic acid. [NOTE—Shikimic acid coelutes with ascorbic acid in this system.] In addition, the *Sample solution* does not exhibit peaks at the retention times of tartaric acid and fumaric acid in *Standard solution B*.

• B. HPTLC FOR ARTICLES OF BOTANICAL ORIGIN (203)

Standard solution A: 0.2 mg/mL each of [USP Chlorogenic Acid RS](#), [USP Cyanidin-3-O-glucoside Chloride RS](#), [USP Hyperoside RS](#), and [USP Quercetin RS](#) in [methanol](#). Sonicate to dissolve.

Standard solution B: 1 mg/mL each of [USP \(-\)-Epicatechin RS](#) and [USP Procyanidin A2 RS](#) in [methanol](#). Sonicate to dissolve.

Standard solution C: Mix 50 mg of [USP Cranberry Fruit Juice Dry Extract RS](#) with 7 mL of water. Sonicate for 10 min at room temperature, centrifuge, and save the supernatant. Precondition a solid phase extraction (SPE) cartridge ([L2](#); 500 mg/6 mL) with 3 mL of [methanol](#), and drain it with suction. Load 3 mL of [water](#) onto the cartridge and apply suction until the solvent reaches 1–2 mm above the upper part of the cartridge's stationary phase. Then load the cartridge with 1.5 mL of the supernatant, apply suction, and discard the eluate. Add 1 mL of [water](#) and [methanol](#) (80:20), apply suction, and discard the eluate. Load 1 mL of [methanol](#) and collect the eluate as *Standard solution C*.

Sample solution: Precondition an SPE cartridge ([L2](#); 500 mg/6 mL) with 3 mL of [methanol](#) and drain it with suction. Load 3 mL of [water](#) onto the cartridge and apply suction until the solvent reaches 1–2 mm above the upper part of the cartridge's stationary phase. Then load the cartridge with 150 µL of Cranberry Fruit Juice Concentrate, apply suction, and discard the eluate. Add 1 mL of a mixture of [water](#) and [methanol](#) (80:20), apply suction, and discard the eluate. Load 1 mL of [methanol](#) and collect the eluate as the *Sample solution*.

Chromatographic system

(See standard parameters as defined in [HPTLC for Articles of Botanical Origin \(203\)](#), [Table 1](#).)

Application volume: 2 µL each of *Standard solution A* and *Standard solution B*, 5 µL of *Standard solution C*, and 10 µL of the *Sample solution*

Developing solvent system: [Ethyl formate](#), [formic acid](#), [water](#), and [toluene](#) (60:8:6:3)

Derivatization reagent A: 5 mg/mL of [2-aminoethyl diphenylborinate](#) in [ethyl acetate](#)

Derivatization reagent B: 170 mL of ice-cooled [methanol](#) mixed with 20 mL of [glacial acetic acid](#), 10 mL of [sulfuric acid](#), and 1 mL of [p-anisaldehyde](#)

Analysis

Samples: *Standard solution A*, *Standard solution B*, *Standard solution C*, and *Sample solution*

Apply the *Samples* as bands and dry in air. Develop in a saturated chamber, remove the plate from the chamber, and dry the plate at 100° for 3 min. Treat the warm plate with *Derivatization reagent A*, and examine the chromatograms under white light and under long-wave UV light. Then treat the plate with *Derivatization reagent B*, heat for 2 min at 100°, and examine under white light.

System suitability

Derivatization reagent A

Under white light: *Standard solution A* exhibits a purple band in the lower-third section corresponding to cyanidin-3-O-glucoside, a yellow band in the middle-third section corresponding to hyperoside, and a yellow band in the upper-third section corresponding to quercetin.

Standard solution C exhibits a set of two purple bands in the lower-third section, which alternate with two pink bands. In increasing R_f values, the first purple band corresponding in R_f to cyanidin-3-*O*-glucoside in *Standard solution A* is due to a coelution of cyanidin-3-*O*-galactoside and cyanidin-3-*O*-glucoside; the pink band between the two purple bands is due to a coelution of peonidin-3-*O*-glucoside and peonidin-3-*O*-galactoside; the other pink band above the second purple band is due to peonidin-3-*O*-arabinoside (partially overlapped with a yellow band above it). *Standard solution C* also exhibits a yellow band above peonidin-3-*O*-arabinoside corresponding to hyperoside in *Standard solution A*. In the upper-third section, *Standard solution C* exhibits a yellow band corresponding to quercetin in *Standard solution A*. A series of faint and indistinct yellow bands also may appear in the middle-third section of *Standard solution C* between hyperoside and quercetin.

Under long-wave UV light: *Standard solution A* exhibits a blue band corresponding to cyanidin-3-*O*-glucoside, an intense blue band corresponding to chlorogenic acid, a yellow band due to hyperoside, and another yellow band due to quercetin. *Standard solution C* exhibits bands corresponding in R_f and color to cyanidin-3-*O*-glucoside, chlorogenic acid, hyperoside, and quercetin in *Standard solution A*. *Standard solution C* also exhibits a brick-orange band right above cyanidin-3-*O*-glucoside corresponding to a coelution of peonidin-3-*O*-glucoside and peonidin-3-*O*-galactoside. A dark blue band and a series of two to three bright yellow bands may appear in the middle-third section of *Standard solution C* between hyperoside and quercetin.

Derivatization reagent B

Under white light: *Standard solution B* exhibits two brown bands in the upper-half section corresponding to procyanidin A2 and epicatechin. *Standard solution C* exhibits two brown bands in the upper-half section corresponding in R_f and color to procyanidin A2 and epicatechin in *Standard solution B*. *Standard solution C* also exhibits a series of faint or indistinct brown bands of differing intensities below procyanidin A2 in the lower-half section.

Acceptance criteria

Derivatization reagent A

Under white light: The *Sample solution* exhibits a set of two purple bands, which alternate with two pink bands in the lower-third section corresponding to the same bands in *Standard solution C*. The purple band with the lower migration, corresponding in R_f to cyanidin-3-*O*-glucoside in *Standard solution A*, is due to a coelution of cyanidin-3-*O*-galactoside and cyanidin-3-*O*-glucoside. The *Sample solution* also exhibits two yellow bands corresponding in R_f and color to hyperoside and quercetin in *Standard solution A*. No purple band at an R_f similar to hyperoside appears (absence of malvidin-3-*O*-glucoside, characteristic of grape skin extract as an adulterant). A series of faint and indistinct yellow bands also may appear in the middle-third section of the *Sample solution* between hyperoside and quercetin corresponding to the same bands in *Standard solution C*. No band appears below the band with an R_f corresponding to cyanidin-3-*O*-glucoside. [NOTE—The occurrence of any purple bands between the sample application and cyanidin-3-*O*-glucoside may indicate the presence of other cyanidin sources including hibiscus, blueberry, or bilberry extracts.]

Under long-wave UV light: The *Sample solution* exhibits a blue band, an intense blue band, and two yellow bands corresponding in R_f and color to cyanidin-3-*O*-glucoside, chlorogenic acid, hyperoside, and quercetin in *Standard solution A*. The *Sample solution* also exhibits the same series of bands between hyperoside and quercetin in *Standard solution C*. The *Sample solution* also exhibits a brick-orange band right above cyanidin-3-*O*-glucoside corresponding to a coelution of peonidin-3-*O*-glucoside and peonidin-3-*O*-galactoside. [NOTE—The occurrence of a yellow–green band near the sample application and below cyanidin-3-*O*-glucoside may indicate the presence of peanut skin extract.]

Derivatization reagent B

Under white light: The *Sample solution* exhibits two faint brown bands corresponding in R_f and color to procyanidin A2 and epicatechin in *Standard solution B*. The *Sample solution* also exhibits a series of faint or indistinct brown bands of differing intensities in the lower-half section, corresponding to the same bands in *Standard solution C*. No bands corresponding in R_f to epigallocatechin-3-*O*-gallate, procyanidin B2, or procyanidin B1 appear below procyanidin A2.

Change to read:

• C. HPLC PROFILE OF FLAVONOIDS

Solution A: 0.3% [phosphoric acid](#)

Solution B: [Acetonitrile](#)

Mobile phase: See [Table 1](#).

Table 1

Time (min)	Solution A (%)	Solution B (%)
0	90	 10

Time (min)	Solution A (%)	Solution B (%)
18.9	80	20
27.3	40	60
27.7	90	10
36.0	90	10

Solvent: [Methanol](#) and 0.3% [phosphoric acid](#) (50:50)

Standard solution: 2 mg/mL of [USP Cranberry Fruit Juice Dry Extract RS](#) in *Solvent*. Transfer an accurately weighed sample to a volumetric flask and dilute with *Solvent*. Vortex for 30 s, sonicate for 5 min, and dilute with *Solvent* to volume. Pass through a suitable membrane filter of 0.22-µm pore size before injection.

Sample solution: Pass the Cranberry Fruit Juice Concentrate through a suitable membrane filter of 0.22-µm pore size and inject directly into the HPLC system.

Chromatographic system
(See [Chromatography \(621\), System Suitability](#).)

Mode: LC

Detector: UV 365 and 520 nm. [NOTE— If a diode array detector is used, select a spectra range of 190–▲600▲ (USP 1-May-2024) nm.]

Column: 4.6-mm × 150-mm; 3.5-µm packing [L1](#)

Column temperature: 25°

Flow rate: 1.0 mL/min

Injection volume: 5 µL

System suitability

Sample: *Standard solution*

Suitability requirements

Resolution: NLT 2 between cyanidin-3-O-arabinoside and peonidin-3-O-galactoside

Chromatogram similarity: The chromatograms of the *Standard solution* are similar to the reference chromatograms provided with the lot of [USP Cranberry Fruit Juice Dry Extract RS](#) being used.

Analysis

Samples: *Standard solution* and *Sample solution*

Inject the *Samples*. Using the chromatograms of the *Standard solution* and the reference chromatograms provided with the lot of [USP Cranberry Fruit Juice Dry Extract RS](#) being used, identify the retention times of the relevant peaks.

Acceptance criteria: The chromatogram of the *Sample solution* is similar to the chromatogram of the *Standard solution* at 365 and 520 nm.

Profile at 365 nm: The *Sample solution* exhibits four characteristic peaks due to myricetin-3-O-galactoside, quercetin-3-O-galactoside (hyperoside), myricetin, and quercetin corresponding to the retention times of the same constituents in the *Standard solution*. No characteristic peaks appear before myricetin-3-O-galactoside. Three minor peaks corresponding to myricetin–pentoside derivatives in the *Standard solution* appear between myricetin-3-O-galactoside and quercetin-3-O-galactoside. Additionally, a series of five minor peaks might appear between quercetin-3-O-galactoside and myricetin in the *Standard solution*, in increasing $R_{T\Delta}$ (USP 1-May-2024) : one due to quercetin-3-O-glucoside (coeluted), three due to quercetin–pentoside derivatives, and one due to quercetin-3-O-rhamnoside (coeluted). No other peak between myricetin-3-O-galactoside and quercetin is more intense than the peaks corresponding to myricetin–pentoside derivatives.

Profile at 520 nm: The *Sample solution* exhibits the peaks of cyanidin-3-O-galactoside, cyanidin-3-O-glucoside, cyanidin-3-O-arabinoside, peonidin-3-O-galactoside, peonidin-3-O-glucoside, and peonidin-3-O-arabinoside corresponding to the retention times of the same constituents in the *Standard solution*. Cyanidin-3-O-galactoside, cyanidin-3-O-arabinoside, peonidin-3-O-galactoside, and peonidin-3-O-arabinoside are the four major peaks. Cyanidin-3-O-glucoside and peonidin-3-O-glucoside appear as minor peaks; cyanidin and peonidin appear as minor peaks or are absent. No other peak between cyanidin-3-O-galactoside and peonidin-3-O-arabinoside is more intense than the peak for cyanidin-3-O-glucoside. The peak area ratio of peonidins (sum of peonidin-3-O-galactoside and ▲peonidin-3-O-arabinoside▲ (USP 1-May-2024)) and cyanidins (sum of cyanidin-3-O-galactoside and cyanidin-3-O-arabinoside) ranges between 0.5 and 1.9.

COMPOSITION

• **CONTENT OF DEXTROSE AND FRUCTOSE**

Mobile phase: [Acetonitrile](#) and [water](#) (83:17)