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Research Article

Comparison of Nutrients and Antioxidant Activities in Sweet Potatoes

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Sweet potato has played an important role in human diets for centuries. Sweet potato is an excellent source of nutrients and natural health-promoting chemicals such as carotenoids, vitamin C, and polyphenols. In this article, we selected forty-eight sweet potato cultivars to evaluate the contents of proximate compositions, phytochemicals, and total antioxidative capacity (TAC). In addition, the sensory taste test was conducted as well. The concentrations of chemical constituents varied significantly among the 48 cultivars. The starch content ranged from 10.58% to 28.08%. The protein concentration was between 2.00% and 12.16%. A noticeable variability was found in vitamin C (8.17–66.09 $mg{\cdot}100\,g^{-1}$), total polyphenols (0.32–13.82 $\mu g{\cdot}g^{-1}$), and carotenoids (0.22–559.70 $\mu g{\cdot}g^{-1}$). 3,5-dicaffeoylquinic acid was the dominant phenolic acid derivative in all varieties, followed by chlorogenic acid. The content ranges of 3,5-dicaffeoylquinic acid and chlorogenic acid were 0.41–92.18 $\mu g{\cdot}100\,g^{-1}$ and 1.59–63.98 $\mu g{\cdot}100\,g^{-1}$, respectively. Remarkable DPPH (0.19–0.59 $\mu g{\cdot}g^{-1}$) and $ABTS^+$ (0.19–1.42 $\mu g{\cdot}g^{-1}$) antioxidant activities were also observed in these sweet potatoes. TAC was related to vitamin C, carotenoids, total polyphenols, and caffeic acid derivatives. The purple flesh cultivars, especially Mianzishu-9, Jiheishu-1, and Qianshu-18-5-1, rich in protein, starch, and antioxidants, had immense potential to improve malnutrition and hidden hunger. The dark orange flesh cultivars Hongxiangjiao and Ziyunhongxinshu performed best in sensory taste evaluation, but the nutrients and antioxidant effects were ordinary. These cultivars were suitable for enriching the human food systems.

1. Introduction

Sweet potato (*Ipomoea batatas* (L.) Lam), known as groundnut and white potato, belongs to the Convolvulaceae or morning glory family. Sweet potato has been a staple food source in Central and South America for centuries. In Asia, sweet potato also provides an important source of starch in China, Korea, and Vietnam [1–3].

As a commercial crop, sweet potato is cultivated worldwide because it is barren tolerant, high yielding, and widely adaptable to different climates and farming systems [4]. It contains abundant nutrients, including protein, carbohydrates, minerals, vitamins, carotenoids, dietary fiber, and polyphenols. Previous studies have reported that sweet potato has many beneficial effects such as antioxidation [5–7], anticancer [8, 9], anti-inflammatory [10], liver protection [11], and prevention of cardiovascular disease [12]. Owing to its nutritional components and agronomic advantages, sweet potato could help prevent and reduce mal- or overnutrition in developing and developed countries. In Japan and the United States, it is valued as "longevity food" [13]. The National Aeronautics and Space Administration has selected sweet potato as a candidate food for astronauts on space missions. Besides direct consumption, sweet potato has been processed into value-added products including starch, flour, noodles, sugar bread, dessert, jams, tapioca, and natural food colorants [14].

However, global sweet potato demand is decreasing in recent years, and it might be associated with paucity of knowledge about its nutrition and bioactivity. On the other hand, new varieties of sweet potato are appearing constantly. The nutrients of sweet potato vary greatly among different varieties. Finding the characteristics of different varieties would conduce to target consumer group with the "best fit" sweet potato varieties. To this end, the main purpose of this study was to characterize the chemical compositional profile and evaluate antioxidative activity and sensory taste of forty-eight sweet potato varieties.

2. Materials and Methods

2.1. Chemicals and Reagents. 1,1-diphenyl-2-trinitrophenylhydrazine (DPPH) and gallic acid (GA) were purchased from Shanghai Yuan-Ye Biotechnology Co., Ltd. (Shanghai, China). 2,2′-Azino-bis-(3-ethylbenzthiazoline-6-sulphonate) (ABTS) was obtained from Soliarbio (Beijing China). Chlorogenic acid, caffeic acid, 3,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid were supplied by Nanjing Chunqiu Biotechnology Co. Ltd (Nanjing, China). Nitrogen, ethyl acetate, sodium nitrite, ascorbic acid, oxalic acid, copper sulfate, potassium sulfate, sodium hydroxide, sodium acetate, acetylacetone, ammonium sulfate, and formaldehyde were purchased from Tianjin FengChuan Chemical Reagent Technology Co. Inc. (Tianjin, China). All chemicals were analytical grade unless specially mentioned.

2.2. Sweet Potatoes and Biological Trait Measurement. The germplasm resource information of 48 sweet potatoes is shown in Table 1. All of them were cultivated in Guizhou province, China, and were harvested between July and September 2020. Biological traits were determined according to the methods outlined in the "Sweet Potato Germplasm Resources Description Specification" (https://www.gb-gbt.cn/PDF/English.aspx/NYT2939-2016) [15]. The characteristics of the sweet potatoes are described in Table 2.

2.3. Raw Sample Preparation. All the sweet potatoes were fresh with no germination, disease, or rot and stored away from sunlight. Fresh sweet potatoes were cleaned with tap water, and surface water was removed with tissue paper. The sweet potatoes were then cut into slices of 1-2 mm thickness and dried at 60°C. After being weighed, the samples were ground into a fine powder and passed through a 100 mesh sieve. The sample powder was stored at −80°C. All analyses were performed in triplicate.

2.4. Determination of Proximate Composition. The moisture, total starch, crude protein, ash, dietary fiber, and vitamin C content were estimated following the AOAC method [16].

2.5. Carotenoids Extraction and Analysis. The method of extraction was based on the method of Kammona et al. [17] with slight modifications. In brief, sweet potato powder (1.0 g) was accurately weighed and mixed with an equal weight of $CaCO_3$. The mixture was dissolved in 3 ml of distilled water and added with 25 ml of acetone-methanol (7 : 3) and shaken well. The resulting mixture was left undisturbed overnight and centrifuged at 3500 rpm for 5 min. This step was repeated 3 times. The supernatants were collected and placed in a partition funnel with equal volumes distill water and hexane. The hexane layer obtained from the partition funnel was dried under nitrogen. The dry residue was dissolved in 300 μl ethyl acetate. 50 μl of the ethyl acetate extraction solution was added to 950 μl of chloroform. The absorbance was measured at 480 nm, 648 nm, and 666 nm, respectively, by an Agilent UV-visible spectrophotometer (Cary 60, Angilent Technologies Inc., Palo Alto, USA). The calculation was based on the Wellburn equation. The analysis was repeated in triplicate.

2.6. Determination of Total Polyphenol Content (TPC). TPC was determined using the Folin–Ciocalteu method [18–20]. In short, 1.0 g of sweet potato sample was weighed into 20 ml centrifuge tubes. 10 ml methanol was added and the mixture was sonicated at 40 kHz for 30 min. The supernatant was diluted 100 times with methanol and measured spectrophotometrically at 760 nm. Results were expressed as milligrams of chlorogenic acid equivalents. The linear range was between 0 and 60 $\mu g\cdot ml^{-1}$.

0.1 g sweet potato powder was weighed and placed in a 15 ml test tube with a stopper. 10 ml of 70% methanolic water (containing 2 $mg\cdot ml^{-1}$ sodium hydrogen sulfite) was added, and the mixture was sonicated for 30 min at 60°C. The extraction was cooled to ambient temperature and centrifuged at 4000 rpm for 10 min. The supernatant was transferred into a 15 ml brown volumetric flask and diluted with 70% methanolic water to volume. The solution was filtered with a 0.45 μm PTFE syringe filter before high performance liquid chromatography (HPLC) analysis.

Individual phenolic acid derivatives were analyzed using a Waters high performance liquid chromatography system (e2695, Waters Corporation, Milford USA) equipped with a photodiode array (DAD) detector. A reversed phase Waters Sunfire column (C18, 4.6 × 150 mm, 5 μm) was utilized for chromatographic separation. The mobile phase consisted of methanol (solvent A) and 0.1% aqueous formic acid (solvent B). The column temperature was 30°C, the flow rate was 1.0 $ml\cdot min^{-1}$, and the injection volume was 10 μl. DAD spectra were recorded from 210 to 400 nm. The phenolic acids were identified according to retention time and UV spectra with reference to standards. The peak area at 326 nm was used to generate the calibration curve for each standard. The linear ranges of each phenolic acid (chlorogenic, caffeic, 3,5-, 3,4-, and 4,5-dicaffeoylquinic acid) were 1–0.04 $\mu g\cdot ml^{-1}$, 0.0192–0.00048 $\mu g\cdot ml^{-1}$, 1.1–0.044 $\mu g\cdot ml^{-1}$, 0.12–0.0022 $\mu g\cdot ml^{-1}$, and 0.078–0.014 $\mu g\cdot ml^{-1}$, respectively.

2.7. Evaluation of Antioxidant Capacity. A 0.15 g sweet potato sample was accurately weighed and ultrasonically extracted with 3 ml of distilled water. The extract was

Table 1: Origin information of samples.

Varieties (line)	Germplasm resources
Mianzishu-9	Mianyang Academy of Agricultural Sciences
Qianshu-18-5-3	Guizhou Academy of Agricultural Sciences
Ganshu-3	Jiangxi Academy of Agricultural Sciences
Jiheishu-1	Shandong Academy of Agricultural Sciences
Qianshu-18-8-2	Guizhou Academy of Agricultural Sciences
Pushu-32	Puning Agricultural Science Research Institute
Qianshu-5	Guizhou Academy of Agricultural Sciences
Taishu-14	Tai'an Agricultural Science Research Institute
Sushu-14	Jiangsu Academy of Agricultural Sciences
Ziyunhongxinshu	Local varieties in Guizhou province
Hongxiangjiao	Anhui Academy of Agricultural Sciences
Ecaishu-1	Hubei Academy of Agricultural Sciences
Quanshu-830	Quanzhou Agricultural Science Research Institute
Qianshu-407	Guizhou Academy of Agricultural Sciences
Wancaishu-19	Chongqing Three Gorges Academy of Agricultural Sciences
Qianshu-18-5-4	Guizhou Academy of Agricultural Sciences
Kaoshu	Local varieties in Guizhou province
Qianshu-1	Guizhou Academy of Agricultural Sciences
Jishu-26	Shandong Academy of Agricultural Sciences
Pushu-53	Putian Agricultural Science Research Institute
Zhanjiangcaitaishu-71	Zhanjiang Agricultural Science Research Institute
Tongshu-2	Tongren Agricultural Science Research Institute
Sushu-24	Jiangsu Academy of Agricultural Sciences
Qianshu-14	Guizhou Academy of Agricultural Sciences
Anna	Weihai Academy of Agricultural Sciences
Wanshankaoshu	Local varieties in Guizhou province
Chuanshu-1386-4	Sichuan academy of agricultural sciences
Qianshu-18-6-6	Guizhou Academy of Agricultural Sciences
Xiangcaishu-2	Hunan Academy of Agricultural Sciences
Fushu-23	Fujian Academy of Agricultural Sciences
Huangyecaishu	Zhanjiang Agricultural Science Research Institute
Fushu-7-6	Fujian Academy of Agricultural Sciences
Qianshu-12	Guizhou Academy of Agricultural Sciences
Nanshu-99	Nanchong Academy of Agricultural Sciences
Wanshu-9	Chongqing Three Gorges Academy of Agricultural Sciences
Qianshu-18-6-1	Guizhou Academy of Agricultural Sciences
Guangcaishu-3	Guangdong Academy of Agricultural Sciences
Guangcaishu-5	Guangdong Academy of Agricultural Sciences
Qianshu-2	Guizhou Academy of Agricultural Sciences
Xiangshu-18	Hunan Academy of Agricultural Sciences
Qianshu-11	Guizhou Academy of Agricultural Sciences
Chuancaishu-211	Sichuan academy of agricultural sciences
Qianshu-18-5-2	Guizhou Academy of Agricultural Sciences
Qiancaishu-1	Guizhou Academy of Agricultural Sciences
Qiancaishu-2	Guizhou Academy of Agricultural Sciences
Fushu-18	Fujian Academy of Agricultural Sciences
Zhanjiangxiyecaishu	Zhanjiang Agricultural Science Research Institute
Xushu-18	Xuzhou Academy of Agricultural Sciences

centrifuged at 4000 rpm for 15 min. The supernatant was collected and stored at −4°C for the antioxidant tests.

DPPH radical scavenging activity was evaluated by the procedure described by Cumby et al. [21] with some modifications. An aliquot (20 μl) of sample solution was repeated into 180 μl DPPH solution (0.1 mmol·l^{-1} in 95% ethanol). After incubating at room temperature for 30 min in the dark, the absorbance was recorded at 517 nm by a Multiskan Spectrum plate reader (MK3, Thermo Fisher Scientific, Helsinki, Finland).

The method of ABTS$^+$ assay was the procedure described by Re et al. [22]. The ABTS$^+$ solution (8 mM) and potassium persulfate (3 mM) were mixed in equal quantities and reacted for 12 h at room temperature in the dark for preparation of the working solution. 20 μl of the sample was mixed with 180 μl of the working solution. The mixture was allowed to react at room temperature in the dark for 2 h. A Multiskan Spectrum plate reader (MK3, Thermo Fisher Scientific, Helsinki, Finland) was used to read the absorbance at 734 nm. The scavenging rates of DPPH and ABTS

Table 2: Biological characteristics of samples.

Varieties (line)	Leaf shape	Leaf color	Skin color	Meat color
Mianzishu-9	Seven cracks in the middle of the notch	Green	Purple	Purple
Qianshu-18-5-3	Absence in the five lobes	Green	Purple	Purple
Ganshu-3	Three cracks with extremely shallow notches	Light green	Red	Purple
Jiheishu-1	Triangle	Green	Deep purple	Deep purple
Qianshu-18-8-2	Heart shaped	Green	Light red	White Purple
Pushu-32	Heart shaped	Light green	Crimson	Dark orange
Qianshu-5	Heart shaped	Light green	Red	Dark orange
Taishu-14	Heart shaped	Green	Dark orange	Dark orange
Sushu-14	Triangle	Green	Red	Dark orange
Ziyunhongxinshu	Heart shaped	Light green	Yellow	Dark orange
Hongxiangjiao	Five split with extremely shallow notches	Light green	Yellow	Dark orange
Ecaishu-1	Heart shaped	Green	Dark orange	Yellow orange
Quanshu-830	Triple fissure shallow notches	Green	Yellow	Yellow orange
Qianshu-407	Three cracks with extremely shallow notches	Green	Red	Yellow orange
Wancaishu-19	Five split with deep notches	Green	Deep purple	Yellow orange
Qianshu-18-5-4	Heart shaped	Green	Red	Light orange
Kaoshu	Triangle	Light green	Crimson	Light orange
Qianshu-1	Seven cracks in the middle of the notch	Green	Red	Yellow
Jishu-26	Heart shaped	Green	Red	Yellow
Pushu-53	Three split with deep notches	Green	Red	Yellow
Zhanjiangcaitaishu-71	Heart shaped	Light green	Pale yellow	Yellow
Tongshu-2	Heart shaped	Light green	Red	Yellow
Sushu-24	Five cracks and shallow notches	Green	Red	Yellow
Qianshu-14	Triple fissure shallow notches	Green	Red	Yellow
Anna	Triple fissure shallow notches	Green	Red	Yellow
Wanshankaoshu	Five cracks and shallow notches	Green	Yellow	Yellow
Chuanshu-1386-4	Triple fissure shallow notches	Green	Red	Yellow
Qianshu-18-6-6	Five cracks and shallow notches	Light green	Crimson	Pale yellow
Xiangcaishu-2	Triangle	Green	Red	Pale yellow
Fushu-23	Heart shaped	Purple	Yellow	Pale yellow
Huangyecaishu	Heart shaped	Chartreuse	Pale yellow	Pale yellow
Fushu-7-6	Heart shaped	Light green	Light red	Pale yellow
Qianshu-12	Three cracks in the middle of the notch	Green	Yellow	Pale yellow
Nanshu-99	Heart shaped	Green	Purplish red	Pale yellow
Wanshu-9	Three cracks in the middle of the notch	Green	Red	Pale yellow
Qianshu-18-6-1	Three cracks in the middle of the notch	Green	Red	Pale yellow
Guangcaishu-3	Heart shaped	Green	Pale yellow	White
Guangcaishu-5	Five cracks and shallow notches	Light green	Pale yellow	White
Qianshu-2	Triple fissure shallow notches	Green	Red	White
Xiangshu-18	Five split with extremely deep notches	Green	Red	White
Qianshu-11	Heart shaped	Green	Red	White
Chuancaishu-211	Three cracks with extremely shallow notches	Green	Light red	White
Qianshu-18-5-2	Heart shaped	Green	Red	White
Qiancaishu-1	Heart shaped	Light green	Pale yellow	White
Qiancaishu-2	Heart shaped	Light green	Light red	White
Fushu-18	Heart shaped	Light green	Yellow	White
Zhanjiangxiyecaishu	Three split with deep notches	Light green	Pale yellow	White
Xushu-18	Heart shaped	Green	Purple	White

relative to the control were calculated using the following equation:

$$\text{antioxidant activity (\%)} = \left[\frac{(A_0 - A_1)}{A_0}\right] * 100\%, \quad (1)$$

where A_0 indicates the absorbance value of the blank control (20 μl ethanol) and A_1 indicates the absorbance of the sample. Ascorbic acid (50 mg·ml^{-1}) served as a standard antioxidant compound.

2.8. Sensory Analysis. A semitrained panel comprising workers, students, and teachers was organized to conduct the assessment of sensory traits, using an evaluation group consisting of 30 people and a 1 : 1 male to female ratio for evaluation. Samples of the 48 cultivars of sweet potatoes were placed in labeled dishes and steamed for 30 min. The cooked samples were served to panelists randomly and evaluated for taste, texture, sweetness, bitterness, fragrance, and smoothness on a hedonic scale. The scoring criteria are listed in Table 3.

Table 3: Sensory evaluation criteria for steamed sweet potato.

Project category	Sensory evaluation criteria	Score
Bitterness	Liked very much	13–15
	Liked moderate	11-12
	Liked slightly	8–12
	Disliked moderately	5–7
	Disliked very much	0–5
Fragrance	Liked very much	13–15
	Liked moderate	11-12
	Liked slightly	8–12
	Disliked moderately	5–7
	Disliked very much	0–5
Sweetness	Liked very much	20–25
	Liked moderate	15–20
	Liked slightly	10–15
	Disliked moderately	5–10
	Disliked very much	0–5
Smoothness	Liked very much	20–25
	Liked moderate	15–20
	Liked slightly	10–15
	Disliked moderately	5–10
	Disliked very much	0–5
Texture	Liked very much	16–20
	Liked moderate	12–16
	Liked slightly	8–12
	Disliked moderately	4–8
	Disliked very much	0–4

2.9. Cluster Analysis. Based on biological characteristics identified, such as leaf shape, leaf color, skin color, and flesh color of sweet potatoes (Table 2), we encoded the data to reflect these morphological characteristics. These encoded data were then analyzed using EXCEL, and a dendrogram was constructed with SPSS 25 to perform hierarchical cluster analysis on 48 sweet potato varieties. This analysis facilitated the classification of these varieties into distinct clusters, enabling us to measure the distance or dissimilarity between them. The cluster analysis results provide insights into the genetic diversity and potential functional properties of these sweet potato varieties.

2.10. Statistical Analysis. All data were shown as the means ± SD. P values were determined by one-way ANOVA. $P < 0.05$ was considered to be statistically significant. Data were analyzed by SPSS 25 software (IBM SPSS Statistics 25.0, Armonk, NY, USA). Statistical significance was considered at $p < 0.05$.

3. Results

3.1. Proximate Compositions. Proximate compositions of sweet potato samples are presented in Table 2. For the convenience of statistics, we classify the color of sweet potato flesh as purple, deep purple, and white purple as purple; orange, orange yellow, and light orange as orange; and yellow and light yellow as yellow in Figure 1. All 48 species of sweet potatoes showed a high moisture content and met the consumption and processing requirement as shown in Table 4. However, the water content showed noticeable variations in different color tuber flesh cultivars. Purple tuber flesh species had lower average water content than others. Taishu-14 exhibited the highest water content of 80.26%, followed by Zhanjiangcaitaishu-71 (79.39%) and Ecaishu-1 (79.04%). The lowest water content was noticed in Jiheishu-1 and Anna, with a value around 61.00%.

Starch is the main carbohydrate of sweet potato root and accounts for approximately 80% of the sweet potato dry matter. Sweet potato starch can be processed into diverse products such as glucose syrup, processed foods, and food additives in different industries, which generates more income [23]. Therefore, the starch content is a crucial standard to measure the quality of sweet potatoes. Pale yellow flesh cultivar Nanshu-99, yellow flesh cultivar Qianshu-14, and purple-flesh cultivar Jiheishu-1, which had the greatest dry matter, also had the highest starch content of 28.08%, 26.37%, and 26.30%, respectively. Cultivar Ziyunhongxinshu which had the lowest dry matter also had the least starch content (13.48%). The average starch content of purple-flesh varieties was over 22.89%, obviously higher than other color flesh cultivars. Dark orange flesh genotypes had less starch than others, with an average of 15.21%. The starch content in yellow flesh cultivars (20.21%) was slightly higher than in pale yellow (19.22%), yellow orange (18.91%), and white (18.66%) flesh cultivars.

Although sweet potato is not considered a rich-protein plant, there was a dramatic difference in the protein content among these samples. The top protein content was noted in varieties Jiheishu-1, Fushu-7-6, Ganshu-3, Mianzishu-9, and Qianshu-18-6-1, which contained 12.16%, 11.23%, 11.15%, 10.56%, and 10.22%, respectively. The protein contents in these five cultivars were higher than potato and rice, which means they were fit for staple consumption and reduced malnutrition in developing countries. Among these five cultivars, Jiheishu-1, Ganshu-3, and Mianzishu-9 were purple flesh, and the two remaining cultivars were pale yellow genotypes. The lowest protein content (2.00 ± 1.10% FW) was observed in Qianshu-14, which was way below other species.

The ash content of these test-varieties ranged from 1.69% to 4.02%. The lowest ash content was recorded in Qianshu-11, while the highest was in Qianshu-5.

The range of the dietary fiber content was from 0.54% in Qianshu-2 to 3.52% in Guangcaishu-3. The highest value was found in Guangcaishu-3. The fiber content of most cultivated varieties was approximately 2%. The high fiber content could affect the texture of sweet potato. On the other hand, dietary fiber is beneficial for constipation by promoting the growth of probiotics [24].

3.2. Bioactive Chemicals. Vitamin C, carotenoids, and total phenolic content (TPC) of the sweet potatoes are described in Table 5. All the cultivars contained vitamin C. The greatest vitamin C content was found in Mianzishu-9 ($66.09 \pm 0.26\ \mathrm{mg \cdot 100\ g^{-1}}$ dry weight, DW), followed by Sushu-14 ($57.94 \pm 0.63\ \mathrm{mg \cdot 100\ g^{-1}}$ DW) and Qianshu-18-5-3 ($54.05 \pm 0.32\ \mathrm{mg \cdot 100\ g^{-1}}$ DW). Fushu-23

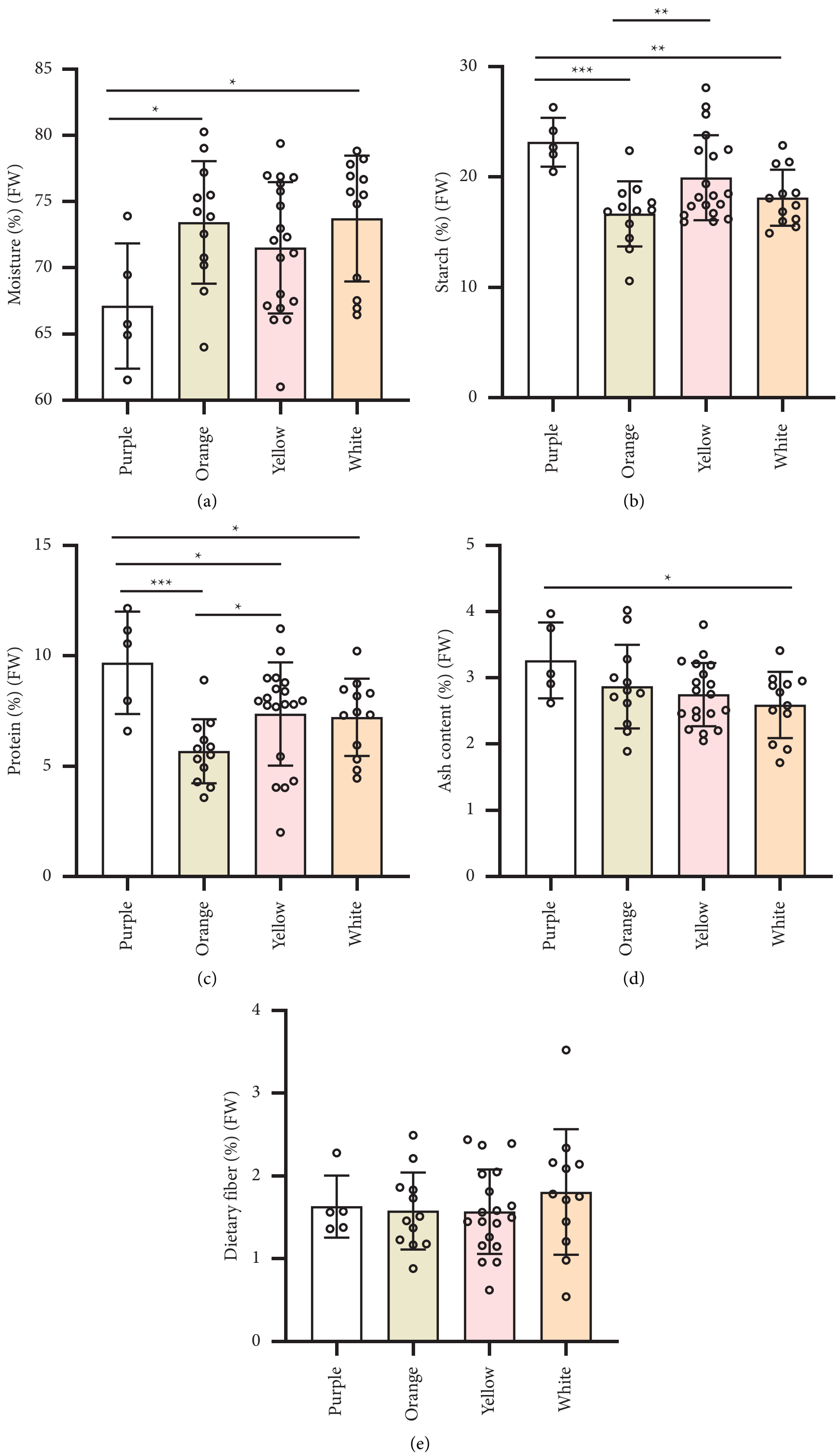

Figure 1: Mean performance for proximate compositions of different color fleshed sweet potato. (a) Moisture content (%); (b) starch content (%); (c) protein content (%); (d) ash content (%); (e) dietary fiber content (%). Dates are expressed as the means ± SD, and the statistical differences were analyzed by one-way ANOVA. $^{*}P < 0.05$, $^{**}P < 0.01$, and $^{***}P < 0.001$.

Table 4: Proximate compositions of 48 sweet potato cultivars.

Cultivars	Moisture (%) (FW)	Starch (%) (FW)	Protein (%) (FW)	Ash content (%) (FW)	Dietary fiber (%) (FW)
Mianzishu-9	65.74 ± 2.60	22.07 ± 1.50	10.56 ± 1.13	3.75 ± 0.27	1.38 ± 0.03
Qianshu-18-5-3	69.46 ± 2.33	20.49 ± 1.20	7.97 ± 1.20	3.06 ± 0.09	2.28 ± 0.03
Ganshu-3	73.91 ± 2.14	22.70 ± 1.14	11.15 ± 1.11	2.62 ± 0.03	1.36 ± 0.02
Jiheishu-1	61.54 ± 1.89	26.30 ± 1.46	12.16 ± 1.10	3.97 ± 0.51	1.57 ± 0.02
Qianshu-18-8-2	64.92 ± 2.51	24.20 ± 1.30	6.59 ± 1.14	2.91 ± 0.14	1.56 ± 0.03
Pushu-32	72.56 ± 2.21	18.89 ± 1.23	5.80 ± 1.13	3.28 ± 0.07	0.88 ± 0.01
Qianshu-5	74.23 ± 1.23	17.00 ± 1.18	8.90 ± 1.11	4.02 ± 0.13	1.18 ± 0.02
Taishu-14	80.26 ± 1.85	10.58 ± 1.33	5.52 ± 1.14	2.81 ± 0.28	1.86 ± 0.02
Sushu-14	75.29 ± 1.47	16.87 ± 1.26	4.29 ± 1.10	2.77 ± 0.63	1.73 ± 0.01
Ziyunhongxinshu	64.01 ± 1.94	13.48 ± 1.15	3.58 ± 1.12	2.30 ± 0.19	1.51 ± 0.04
Hongxiangjiao	75.48 ± 1.99	14.46 ± 1.14	6.97 ± 1.20	3.00 ± 0.25	2.21 ± 0.01
Ecaishu-1	79.04 ± 1.79	16.94 ± 1.17	4.05 ± 1.20	2.93 ± 0.29	1.23 ± 0.03
Quanshu-830	70.76 ± 2.74	17.29 ± 1.27	6.19 ± 1.10	1.89 ± 0.22	1.37 ± 0.03
Qianshu-407	68.23 ± 1.23	17.68 ± 1.36	5.88 ± 1.11	3.88 ± 0.19	1.46 ± 0.06
Wancaishu-19	77.19 ± 2.54	18.50 ± 1.19	4.94 ± 1.23	2.19 ± 0.09	2.49 ± 0.05
Qianshu-18-5-4	70.20 ± 1.22	22.39 ± 1.22	6.73 ± 1.13	2.71 ± 0.17	1.83 ± 0.03
Kaoshu	73.86 ± 1.58	15.76 ± 1.42	5.33 ± 1.14	2.62 ± 0.02	1.17 ± 0.01
Qianshu-1	67.46 ± 2.12	23.78 ± 1.30	4.03 ± 1.11	2.40 ± 0.31	2.37 ± 0.01
Jishu-26	72.07 ± 1.67	17.35 ± 1.25	4.04 ± 1.15	2.75 ± 0.17	1.64 ± 0.05
Pushu-53	76.36 ± 1.43	16.53 ± 1.19	9.01 ± 1.11	3.80 ± 0.06	1.56 ± 0.04
Zhanjiangcaitaishu-71	79.39 ± 1.39	15.93 ± 1.09	7.76 ± 1.02	3.35 ± 0.16	1.15 ± 0.03
Tongshu-2	67.13 ± 1.01	25.68 ± 1.20	8.09 ± 1.05	2.05 ± 0.22	1.50 ± 0.03
Sushu-24	66.07 ± 2.54	22.41 ± 1.33	7.95 ± 1.00	3.05 ± 0.25	2.02 ± 0.01
Qianshu-14	66.07 ± 2.32	26.37 ± 1.21	2.00 ± 1.10	2.15 ± 0.21	1.26 ± 0.03
Anna	61.00 ± 1.58	17.46 ± 1.39	8.99 ± 1.14	2.22 ± 0.24	0.62 ± 0.01
Wanshankaoshu	68.00 ± 2.59	21.89 ± 1.43	5.44 ± 1.12	2.46 ± 0.14	0.96 ± 0.02
Chuanshu-1386-4	71.12 ± 2.66	18.31 ± 1.14	7.69 ± 1.13	2.90 ± 0.05	1.43 ± 0.05
Qianshu-18-6-6	70.75 ± 2.91	18.17 ± 1.16	8.51 ± 1.12	2.51 ± 0.18	1.58 ± 0.02
Xiangcaishu-2	76.97 ± 1.63	19.38 ± 1.21	8.39 ± 1.21	2.50 ± 0.14	1.16 ± 0.02
Fushu-23	75.79 ± 2.41	17.53 ± 1.35	7.97 ± 1.11	2.20 ± 0.17	0.96 ± 0.01
Huangyecaishu	72.33 ± 2.45	16.72 ± 1.19	8.79 ± 1.14	2.93 ± 0.23	2.44 ± 0.01
Fushu-7-6	76.89 ± 3.03	16.18 ± 1.24	11.23 ± 1.20	3.19 ± 0.14	2.39 ± 0.02
Qianshu-12	72.96 ± 3.21	15.96 ± 1.26	7.80 ± 1.11	3.21 ± 0.14	2.05 ± 0.04
Nanshu-99	74.68 ± 2.16	28.08 ± 1.17	7.80 ± 1.10	3.25 ± 0.25	1.81 ± 0.02
Wanshu-9	76.83 ± 2.33	22.49 ± 1.18	4.33 ± 1.16	2.81 ± 0.22	1.45 ± 0.02
Qianshu-18-6-1	66.95 ± 3.21	18.48 ± 1.27	10.22 ± 1.15	2.46 ± 0.15	1.45 ± 0.06
Guangcaishu-3	75.51 ± 1.94	17.45 ± 1.25	8.48 ± 1.62	2.90 ± 0.23	3.52 ± 0.01
Guangcaishu-5	77.82 ± 1.57	16.86 ± 1.11	5.32 ± 1.18	1.99 ± 0.14	2.16 ± 0.03
Qianshu-2	66.45 ± 1.39	21.21 ± 1.16	5.95 ± 1.10	2.78 ± 0.11	0.54 ± 0.01
Xiangshu-18	74.82 ± 1.66	15.48 ± 1.15	7.31 ± 1.12	2.88 ± 0.42	2.09 ± 0.03
Qianshu-11	66.95 ± 3.21	18.48 ± 1.27	10.22 ± 1.15	2.46 ± 0.15	1.45 ± 0.06
Chuancaishu-211	76.92 ± 2.54	15.98 ± 1.20	4.83 ± 1.14	2.51 ± 0.15	1.71 ± 0.03
Qianshu-18-5-2	69.23 ± 2.31	22.87 ± 1.32	8.18 ± 1.11	1.92 ± 0.19	0.98 ± 0.02
Qiancaishu-1	76.67 ± 1.47	14.90 ± 1.14	7.46 ± 1.15	3.41 ± 0.24	1.75 ± 0.01
Qiancaishu-2	78.83 ± 1.93	21.37 ± 1.28	8.31 ± 1.12	2.58 ± 0.23	2.34 ± 0.01
Fushu-18	75.74 ± 2.31	18.56 ± 1.13	4.46 ± 1.04	1.72 ± 0.18	1.21 ± 0.02
Zhanjiangxiyecaishu	78.21 ± 2.11	16.19 ± 1.08	8.74 ± 1.01	2.95 ± 0.22	1.78 ± 0.01
Xushu-18	67.53 ± 2.16	18.09 ± 1.15	7.33 ± 1.09	2.98 ± 0.15	2.14 ± 0.04

FW: fresh weight.

and Ganshu-3 were also rich in vitamin C with values of $52.86 \pm 0.16\,mg\cdot 100\,g^{-1}$ and $49.95 \pm 0.42\,mg\cdot 100\,g^{-1}$, respectively. The lowest content of vitamin C was obtained from Xushu-18 ($8.17 \pm 0.16\,mg\cdot 100\,g^{-1}$). The purple flesh cultivars had more vitamin C than others, which could play an important role in vitamin C deficiency. The average vitamin C level was lower in varieties with the yellow tuber.

Likewise, the carotenoids content varied greatly among different varieties of sweet potatoes. The carotenoids level was associated with the flesh color of sweet potato. Dark orange tuber flesh cultivars contained much higher carotenoids than other color cultivars [25]. In this work, dark orange flesh Pushu-32 ranked the highest with a value of $559.70\,\mu g\cdot g^{-1}$, followed by Taishu-14, Sushu-14, and Qianshu-5. The carotenoids level in these varieties was

Table 5: Mean performance for vitamin C, carotenoids, and TPC of 48 sweet potato cultivars.

Cultivars	Vitamin C (mg·100 g^{-1}·DW)	Carotenoids (μg·g^{-1}·DW)	TPC (μg·g^{-1}·DW)
Mianzishu-9	66.09 ± 0.26	0.91 ± 0.33	13.82 ± 0.02
Qianshu-18-5-3	54.05 ± 0.32	1.98 ± 0.11	4.65 ± 0.02
Ganshu-3	49.95 ± 0.42	0.89 ± 0.15	1.71 ± 0.06
Jiheishu-1	24.82 ± 0.21	0.37 ± 0.06	4.37 ± 0.05
Qianshu-18-8-2	24.90 ± 0.11	0.54 ± 0.13	0.50 ± 0.01
Pushu-32	24.12 ± 0.19	559.70 ± 7.89	7.49 ± 0.03
Qianshu-5	24.90 ± 0.58	101.10 ± 0.02	5.31 ± 0.02
Taishu-14	24.92 ± 0.21	261.50 ± 0.83	2.06 ± 0.02
Sushu-14	57.94 ± 0.63	115.20 ± 0.04	2.25 ± 0.01
Ziyunhongxinshu	16.65 ± 0.22	20.61 ± 0.08	1.66 ± 0.04
Hongxiangjiao	37.43 ± 0.28	44.22 ± 0.01	1.39 ± 0.07
Ecaishu-1	32.85 ± 0.27	46.37 ± 0.01	4.17 ± 0.01
Quanshu-830	33.17 ± 0.24	10.74 ± 0.01	3.39 ± 0.03
Qianshu-407	24.83 ± 0.19	43.28 ± 0.01	0.73 ± 0.05
Wancaishu-19	11.62 ± 0.29	7.49 ± 0.01	3.56 ± 0.01
Qianshu-18-5-4	20.55 ± 0.32	9.20 ± 0.02	2.92 ± 0.05
Kaoshu	33.30 ± 0.34	32.48 ± 0.06	0.96 ± 0.01
Qianshu-1	15.59 ± 0.31	25.96 ± 0.08	2.062 ± 0.01
Jishu-26	22.31 ± 0.15	16.06 ± 0.07	4.26 ± 0.02
Pushu-53	16.63 ± 0.24	0.92 ± 0.04	3.63 ± 0.05
Zhanjiangcaitaishu-71	19.79 ± 0.16	0.86 ± 0.01	6.08 ± 0.01
Tongshu-2	16.42 ± 0.27	0.42 ± 0.06	10.38 ± 0.03
Sushu-24	24.10 ± 0.15	4.41 ± 0.03	1.63 ± 0.06
Qianshu-14	8.18 ± 0.24	6.49 ± 0.03	2.61 ± 0.08
Anna	11.64 ± 0.31	7.00 ± 0.01	1.12 ± 0.02
Wanshankaoshu	12.23 ± 0.28	1.31 ± 0.01	1.20 ± 0.03
Chuanshu-1386-4	8.23 ± 0.14	6.12 ± 0.01	0.74 ± 0.01
Qianshu-18-6-6	8.26 ± 0.21	1.24 ± 0.03	1.22 ± 0.01
Xiangcaishu-2	19.14 ± 0.25	0.30 ± 0.04	1.21 ± 0.03
Fushu-23	52.86 ± 0.16	4.46 ± 0.05	3.29 ± 0.01
Huangyecaishu	12.49 ± 0.19	0.42 ± 0.02	1.76 ± 0.02
Fushu-7-6	16.18 ± 0.23	7.95 ± 0.08	1.51 ± 0.05
Qianshu-12	17.43 ± 0.25	0.72 ± 0.01	0.69 ± 0.06
Nanshu-99	12.28 ± 0.21	0.30 ± 0.01	0.76 ± 0.02
Wanshu-9	16.44 ± 0.24	1.91 ± 0.05	0.87 ± 0.04
Qianshu-18-6-1	12.36 ± 0.25	1.25 ± 0.05	0.32 ± 0.01
Guangcaishu-3	12.28 ± 0.19	1.23 ± 0.03	10.37 ± 0.01
Guangcaishu-5	15.81 ± 0.28	0.66 ± 0.02	3.07 ± 0.04
Qianshu-2	12.46 ± 0.25	0.35 ± 0.05	3.04 ± 0.05
Xiangshu-18	33.16 ± 0.31	0.45 ± 0.02	5.54 ± 0.02
Qianshu-11	14.95 ± 0.25	0.60 ± 0.06	1.83 ± 0.04
Chuancaishu-211	14.46 ± 0.22	0.49 ± 0.01	3.39 ± 0.05
Qianshu-18-5-2	16.27 ± 0.27	0.59 ± 0.02	0.95 ± 0.03
Qiancaishu-1	21.28 ± 0.31	0.58 ± 0.03	4.88 ± 0.01
Qiancaishu-2	20.08 ± 0.24	0.22 ± 0.05	1.21 ± 0.02
Fushu-18	22.06 ± 0.22	0.85 ± 0.05	5.39 ± 0.01
Zhanjiangxiyecaishu	24.93 ± 0.32	2.96 ± 0.02	1.30 ± 0.04
Xushu-18	8.17 ± 0.16	0.97 ± 0.01	0.69 ± 0.05

DW: dry weight.

similar to carrots [26]. Pushu-32, Qianshu-5, Taishu-14, and Sushu-14 could be alternative sources of vitamin A. Purple and white flesh tuber cultivars have much less carotenoids, and white flesh Qiancaishu-2 (0.22 μg·g^{-1}) came in last.

The TPC varied remarkably in different cultivars. TPC in the purple tuber flesh cultivar Mianzishu-9 reached 13.82 μg·g^{-1}, followed by Tongshu-2 (10.38 μg·g^{-1}·DW) and Guangcaishu-3 (10.37 μg·g^{-1}·DW). In general, the purple-flesh varieties produced the highest TPC with an average of 6.14 μg·g^{-1} way beyond other genotypes. TPC in the dark orange, yellow, and white flesh varieties was close, ranging from 3.36 μg·g^{-1} in the dark orange type to 2.54 μg·g^{-1} in the yellow type. The least phenolic content was found in pale yellow cultivar Qianshu-18-6-1 (0.32 μg·g^{-1}·DW).

There was a large variation in the phenolics content among the sweet potato varieties [27], and the contents of phenolic acid derivatives are described in Table 6 and Figure 2. 3,5-dicaffeoylquinic acid was the dominant phenolic acid derivative in all varieties. The purple sweet potato Mianzishu-9, Qianshu-18-5-3, and dark orange cultivar Pushu-32 presented higher amount of 3,5-dicaffeoylquinic acid than others, with the number of 92.18 μg·100 g^{-1}, 70.14 μg·100 g^{-1}, and 61.87 μg·100 g^{-1}, respectively. Yellow flesh Zhanjiangcaitaishu-71 and dark orange flesh Qianshu-5 were also rich in 3,5-dicaffeoylquinic acid. Purple flesh cultivars had the highest average 3,5-dicaffeoylquinic acid content (58.12 μg·100 g^{-1}·DW), followed by dark orange cultivars (27.68 μg·100 g^{-1}·DW). There was no significant difference among the orange, yellow, and white genotypes, and the mean value was around 18.60 μg·100 g^{-1}. Chlorogenic acid was the second highest among caffeic acid compounds. The most amount of chlorogenic acid was observed in Mianzishu-9 (63.98 μg·100 g^{-1}·DW) and Qianshu-18-5-3 (57.32 μg·100 g^{-1} DW), similar to 3,5-dicaffeoylquinic acid. Zhanjiangcaitaishu-71 and Guangcaishu-3 also showed a high content of chlorogenic acid compared to the rest of the cultivars. The 3,4-dicaffeoylquinic acid content was much higher than 4,5-dicaffeoylquinic acid in most cultivars, except Mianzishu-9 and Ganshu-3, both purple flesh. The range of 3,4-dicaffeoylquinic acid content was between 0.50 μg·100 g^{-1}·DW (Anna) and 31.80 μg·100 g^{-1}·DW (Taishu-14). Both Chuanshu-1386-4 and Qianshu-18-6-6 had over 13.00 μg·100 g^{-1}·DW of 3,4-dicaffeoylquinic acid. The content of 4,5-dicaffeoylquinic acid varied from 0.49 μg·100 g^{-1}·DW in Ziyunhongxinshu, Kaoshu, and Qianshu-407 to 7.15 μg·100 g^{-1}·DW in Mianzishu-9. The average levels of 3,4-dicaffeoylquinic acid and 4,5-dicaffeoylquinic acid were higher in purple-flesh genotypes, followed by dark orange flesh genotypes. Caffeic acid was the least caffeic acid derivative in all cultivars.

3.3. Total Antioxidant Capacity. Some studies seek to compare the antioxidant potentials of flesh from white and purple-skinned sweet potato. Results show that the evaluated antioxidant indices DPPH and ABTS radical-scavenging capacity against lipid oxidation were higher in peels of the studied potato compared to the flesh [28]. DPPH and ABTS^{+}free-radical scavenging capacity of all varieties are shown in Table 7. TAC (DPPH) of Mianzishu-9 was obviously higher than other cultivars, followed by Pushu-32 and Qianshu-18-5-3. Chuanshu-1386-4 had the lowest TAC (DPPH). Sweet potatoes with purple flesh had stronger DPPH free-radical scavenging activity than others. The performance of Mianzishu-9 on ABTS^{+} quenching capacity was far better over the rest of cultivars. Higher TAC (ABTS^{+}) was recorded in Chuanshu-1386-4, Qianshu-18-5-3, Qianshu-5, Jiheishu-1, and Pushu-32, similar to the rank of DPPH free-radical scavenging capacity. In contrast, TAC (ABTS^{+}) was the lowest in the yellow flesh type Huangyecaishu. The TAC of sweet potato was positively related to the contents of vitamin C, TPC, phenolic acids, and carotenoids. All these compounds with reductive groups have activity scavenging free radicals. Purple flesh varieties which contained the greatest content of vitamin C, TPC, and phenolic acids exhibited potent antioxidative effects. Mianzishu-9 with the highest TPC, phenolic acids, and vitamin C performed best in TAC, followed by Jiheishu-1, both cultivars were purple fleshed. The strong TAC of the dark orange cultivar Pushu-32 was correlated to the abundance of carotenoids. As we know, excessive free radicals could damage large molecules such as proteins, DNA, and cell membrane, causing aging and disease [29]. Ingestion of food with antioxidative effects is beneficial for maintaining homeostasis in the human body. Mianzishu-9, Qianshu-18-5-3, Jiheishu-1, Ganshu-3, Pushu-32, Qianshu-5, and Ecaishu-1 could be selected as antioxidant profile-enriched cultivars.

3.4. Sensory Taste Evaluation. There is research for the sensory evaluation of 12 sweet potatoes with orange, purple, and yellow flesh, and it was found that consumers liked smooth texture, brown sugar and dried apricot flavor, and sweet taste and disliked bitter, umami, astringent mouthfeel, vanilla aroma, and residual fibers [30]. The sensory score is listed in Table 8 and Figure 3. In all 48 cultivars, Hongxiangjiao got the highest score (82.9) for all sensory traits. Ziyunhongxinshu, Qianshu-18-5-4, and Xushu-18 also had good scores. The purple-flesh varieties Qianshu-18-5-3, Jiheishu-1, and Mianzishu-9, which had great contents of starch, protein, and antioxidants, conducted excellent performance on TAC. However, they were less preferred, scoring around 60, owing to the mild bitterness and poor texture. This might be associated with the height content of antioxidants. Polyphenols give a bitter taste, and vitamin C affects the sweetness. Dry matter weight is correlated to the texture of sweet potato. Higher dry matter made the sweet potato less watery, denser, and adhesive. The lower moisture content made the purple cultivars feel lightly dry and firm. Chuancaishu-211, Qiancaishu-2, Wancaishu-19, Huangyecaishu, and Zhanjiangxiyecaishu received low scores in all sensory characters with higher dietary fiber contents. Although dietary fiber has beneficial effects on relieving constipation, promoting the growth of probiotics and decreasing blood sugar levels, it makes the sweet potato taste rough [31]. These cultivars might not be suitable for staple consumption and could be further processed into other products. Generally, the orange and yellow cultivars were favored.

3.5. Correlation Coefficient Analysis. The correlation of bioactive ingredients was analyzed and the results are presented in Table 9. Chlorogenic acid, 3,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid were positively and significantly related to each of them, TPC and TAC (ABTS^{+}). Chlorogenic acid, 3,5-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid were also positively correlated with TAC (DPPH). Caffeic acid had a positive correlation with 3,5-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, and TAC (DPPH). Vitamin C had a positive association with TPC, TAC (ABTS^{+}), and TAC (DPPH). Carotenoids had a positive relationship with caffeic acid, 3,5-dicaffeoylquinic acid, and TAC (DPPH). The correlation of vitamin C and carotenoids with TAC was not accorded with Sarker Umakanta's work in amaranth

Table 6: Caffeic acid derivatives of 48 sweet potato cultivars.

Cultivars	Chlorogenic acid ($\mu g \cdot 100\,g^{-1} \cdot DW$)	Caffeic acid ($\mu g \cdot 100\,g^{-1} \cdot DW$)	3,5-Dicaffeoylquinic acid ($\mu g \cdot 100\,g^{-1}$ DW)	3,4-Dicaffeoylquinic acid ($\mu g \cdot 100\,g^{-1}$ DW)	4,5-Dicaffeoylquinic acid ($\mu g \cdot 100\,g^{-1} \cdot DW$)
Mianzishu-9	63.98 ± 0.31	0.43 ± 0.01	92.18 ± 0.47	6.56 ± 0.12	7.15 ± 0.18
Qianshu-18-5-3	57.32 ± 0.27	0.48 ± 0.16	70.14 ± 0.35	6.52 ± 0.20	5.86 ± 0.20
Ganshu-3	15.22 ± 0.73	0.27 ± 0.01	25.80 ± 0.90	1.37 ± 0.05	0.56 ± 0.02
Jiheishu-1	33.86 ± 0.14	0.50 ± 0.14	44.35 ± 0.20	14.97 ± 0.30	4.41 ± 0.09
Qianshu-18-8-2	4.70 ± 0.11	0.10 ± 0.01	8.98 ± 0.14	1.02 ± 0.05	1.16 ± 0.02
Pushu-32	30.90 ± 0.12	1.72 ± 0.04	61.87 ± 0.19	2.69 ± 0.04	3.66 ± 0.19
Qianshu-5	29.71 ± 0.11	2.66 ± 0.04	47.46 ± 0.22	4.07 ± 0.23	5.99 ± 0.25
Taishu-14	16.39 ± 0.40	1.56 ± 0.05	22.63 ± 0.70	31.80 ± 0.14	1.39 ± 0.07
Sushu-14	11.07 ± 0.10	1.70 ± 0.05	18.20 ± 0.50	1.08 ± 0.05	1.15 ± 0.09
Ziyunhongxinshu	3.02 ± 0.04	0.27 ± 0.01	6.50 ± 0.20	0.68 ± 0.03	0.49 ± 0.01
Hongxiangjiao	8.97 ± 0.01	0.45 ± 0.02	9.44 ± 0.13	1.30 ± 0.05	0.80 ± 0.03
Ecaishu-1	20.41 ± 0.60	0.38 ± 0.01	36.84 ± 0.15	4.61 ± 0.30	3.38 ± 0.14
Quanshu-830	7.28 ± 0.20	0.16 ± 0.01	24.05 ± 0.80	10.58 ± 0.32	1.86 ± 0.05
Qianshu-407	6.03 ± 0.20	0.03 ± 0.01	7.22 ± 0.20	10.00 ± 0.60	0.49 ± 0.02
Wancaishu-19	1.59 ± 0.05	0.35 ± 0.01	7.27 ± 0.20	1.24 ± 0.05	0.57 ± 0.02
Qianshu-18-5-4	9.44 ± 0.16	0.10 ± 0.03	17.06 ± 0.44	3.51 ± 0.14	1.76 ± 0.05
Kaoshu	6.25 ± 0.20	0.27 ± 0.01	8.64 ± 0.10	1.24 ± 0.05	0.49 ± 0.01
Qianshu-1	18.62 ± 0.50	0.02 ± 0.01	28.87 ± 0.11	1.56 ± 0.05	1.73 ± 0.05
Jishu-26	12.36 ± 0.10	0.26 ± 0.01	14.84 ± 0.30	1.16 ± 0.05	1.19 ± 0.05
Pushu-53	17.69 ± 0.40	0.21 ± 0.01	34.77 ± 0.14	3.61 ± 0.16	1.57 ± 0.05
Zhanjiangcaitaishu-71	35.60 ± 0.15	0.94 ± 0.05	57.08 ± 0.27	10.04 ± 0.07	4.37 ± 0.21
Tongshu-2	11.86 ± 0.10	0.22 ± 0.01	12.12 ± 0.10	1.50 ± 0.05	1.20 ± 0.05
Sushu-24	5.61 ± 0.30	0.96 ± 0.06	11.23 ± 0.10	1.07 ± 0.05	0.83 ± 0.05
Qianshu-14	7.91 ± 0.10	0.25 ± 0.01	12.16 ± 0.10	3.55 ± 0.22	0.91 ± 0.05
Anna	5.71 ± 0.30	0.57 ± 0.02	10.89 ± 0.01	0.50 ± 0.02	0.75 ± 0.05
Wanshankaoshu	6.16 ± 0.20	0.20 ± 0.01	0.41 ± 0.09	1.34 ± 0.50	0.74 ± 0.02
Chuanshu-1386-4	28.70 ± 0.04	0.01 ± 0.00	7.78 ± 0.10	13.08 ± 0.20	0.63 ± 0.05
Qianshu-18-6-6	21.35 ± 0.60	1.37 ± 0.05	34.41 ± 0.14	13.08 ± 0.20	4.39 ± 0.13
Xiangcaishu-2	7.35 ± 0.20	0.50 ± 0.01	13.21 ± 0.20	4.44 ± 0.13	1.66 ± 0.05
Fushu-23	11.88 ± 0.10	0.57 ± 0.02	26.45 ± 0.90	2.75 ± 0.04	1.58 ± 0.05
Huangyecaishu	7.28 ± 0.20	0.28 ± 0.01	12.09 ± 0.10	2.27 ± 0.14	1.11 ± 0.05
Fushu-7-6	4.26 ± 0.30	0.11 ± 0.01	7.79 ± 0.10	1.37 ± 0.08	0.99 ± 0.05
Qianshu-12	3.42 ± 0.14	0.31 ± 0.02	8.32 ± 0.10	0.70 ± 0.02	0.72 ± 0.05
Nanshu-99	5.72 ± 0.30	0.02 ± 0.01	10.08 ± 0.14	1.33 ± 0.05	1.08 ± 0.05
Wanshu-9	7.15 ± 0.20	0.21 ± 0.01	10.13 ± 0.45	1.79 ± 0.05	1.07 ± 0.05
Qianshu-18-6-1	3.42 ± 0.18	0.06 ± 0.01	7.88 ± 0.10	0.60 ± 0.05	0.70 ± 0.05
Guangcaishu-3	21.78 ± 0.70	0.03 ± 0.01	35.01 ± 0.14	13.54 ± 0.20	3.74 ± 0.14
Guangcaishu-5	10.01 ± 0.46	0.08 ± 0.01	24.77 ± 0.80	1.70 ± 0.05	1.44 ± 0.05
Qianshu-2	10.94 ± 0.01	0.27 ± 0.01	16.42 ± 0.40	5.29 ± 0.13	1.26 ± 0.05
Xiangshu-18	14.79 ± 0.30	0.14 ± 0.01	45.30 ± 0.20	11.44 ± 0.10	3.51 ± 0.04
Qianshu-11	14.11 ± 0.20	0.35 ± 0.01	16.93 ± 0.40	3.56 ± 0.14	1.94 ± 0.05
Chuancaishu-211	7.27 ± 0.20	0.12 ± 0.01	13.42 ± 0.20	2.72 ± 0.15	0.69 ± 0.02
Qianshu-18-5-2	2.65 ± 0.04	0.10 ± 0.04	7.12 ± 0.20	1.19 ± 0.05	0.68 ± 0.01
Qiancaishu-1	5.98 ± 0.02	2.9 ± 0.01	12.89 ± 0.20	2.33 ± 0.04	1.40 ± 0.05
Qiancaishu-2	5.00 ± 0.03	0.35 ± 0.02	15.03 ± 0.30	8.79 ± 0.10	1.22 ± 0.05
Fushu-18	7.00 ± 0.02	0.02 ± 0.01	19.27 ± 0.50	5.64 ± 0.30	2.61 ± 0.04
Zhanjiangxiyecaishu	4.76 ± 0.30	0.15 ± 0.01	12.12 ± 0.10	2.10 ± 0.05	1.51 ± 0.05
Xushu-18	4.19 ± 0.30	0.11 ± 0.01	6.00 ± 0.20	0.86 ± 0.05	0.52 ± 0.03

[32]. This might be caused by the differences in vitamin C and carotenoids content between sweet potato and amaranth.

Furthermore, we employed hierarchical clustering analysis to illustrate the distance differences between sweet potato varieties, as depicted in Figure 4. Varieties 1, 2, 3, and 4 are closely related, forming one category. A large group comprising varieties 5, 6, 8, 11, 15, 16, 18, 21, 22, 23, 24, 26, 27, 28, 31, 33, 38, 40, 41, 42, 44, 45, 47, and 48 forms another category, indicating high similarity. Varieties 7, 9, 10, 12, 14, 20, 25, 29, 30, 36, 37, and 43 are grouped into a third category. The fourth category includes 13, 17, 19, 32, 34, 35, and 39. Variety 46 is also classified within a specific category. The smaller the distance between varieties in the dendrogram, the higher the similarity between species.

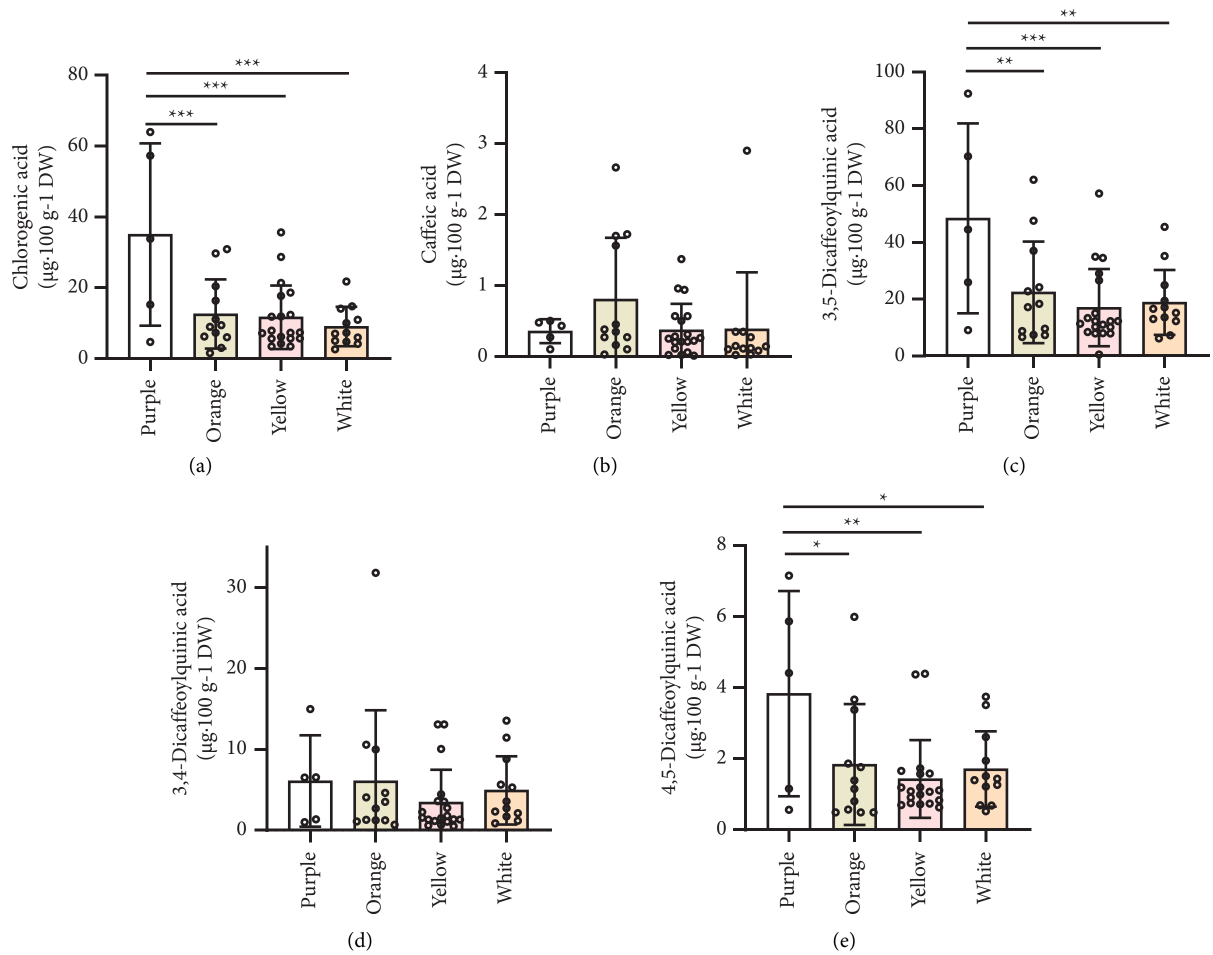

FIGURE 2: Mean performance for caffeic acid derivatives of different color fleshed sweet potato. (a) Chlorogenic acid content (μg·100 g^{-1}·DW); (b) caffeic acid content (μg·100 g^{-1}·DW); (c) 3,5-dicaffeoylquinic acid content (μg·100 g^{-1}·DW); (d) 3,4-dicaffeoylquinic acid content (μg·100 g^{-1}·DW); (e) 4,5-dicaffeoylquinic acid content (μg·100 g^{-1}·DW). Data are expressed as the means ± SD, and the statistical differences were analyzed by one-way ANOVA. $^{*}P < 0.05$, $^{**}P < 0.01$, and $^{***}P < 0.001$.

4. Discussion

Sweet potato, a vital food crop, holds a place of particular importance in tropical and subtropical regions where it serves as a staple food and primary energy source. Its global recognition as one of the world's top ten foods is attributed to its diverse sizes, shapes, colors, and health benefits [33]. The extensive cultivation of sweet potatoes worldwide is driven not only by their nutritional value but also due to their health-promoting properties [34]. In this global context, China has emerged as one of the leading producers, contributing significantly through the development of new varieties that enhance the crop's diversity and utility [35]. Due to the genetic diversity, chemical components along with the bioactive effects are variable in different cultivars [36]. In this present work, we evaluate the sensory taste, proximate composition, phytochemicals, and antioxidant effects in forty-eight cultivars of sweet potato. Our results suggested that sweet potato had abundant nutritional elements together with phytochemicals. Among them, protein is a unique and important nutrient. The crude protein content of sweet potato was generally around 4.00%. In this work, the protein contents of sweet potatoes from 48 varieties ranged from 2.00% to 12.16%. Cultivars containing abundant protein could serve as a complementary source of protein, especially for low-income people. The range of starch content of the 48 genotypes was between 13.48% and 28.08%. The cultivars combined high protein and starch, such as Jiheishu-1, Mianzishu-9, and Ganshu-3, and were ideal for staple consumption.

More recently, the demand for wholesome foods has increased among consumers. Sweet potato possesses abundant functional phytochemicals including vitamin C, carotenoids, polyphenols, and dietary fiber. These constitutions differed significantly in terms of genotypes. Therefore, the selection of stable and high-yielding genotypes and accordance with consumer and industry preferences is one of the focuses of sweet potato research [37]. Our research indicates that the purple-fleshed cultivars Mianzishu-9, Jiheishu-1, and Qianshu-18-5-3 contained remarkably high vitamin C, total polyphenols, and phenolic acids. These cultivars not only displayed stronger antioxidant effects than

Table 7: Average free-radical scavenging performance of TAC (DPPH) and TAC ($ABTS^+$) in 48 sweet potato cultivars.

Meat color	Cultivars	Total antioxidant capacity (TAC) ($\mu g \cdot g^{-1} \cdot DW$)		Total mean ± standard ($\mu g \cdot g^{-1} \cdot DW$)	
		DPPH	$ABTS^+$	DPPH	$ABTS^+$
Purple	Mianzishu-9	0.59 ± 0.03	1.42 ± 0.01	0.46 ± 0.13	0.75 ± 0.41
Purple	Qianshu-18-5-3	0.56 ± 0.08	0.74 ± 0.01		
Purple	Ganshu-3	0.45 ± 0.06	0.64 ± 0.15		
Deep purple	Jiheishu-1	0.45 ± 0.10	0.64 ± 0.09		
White purple	Qianshu-18-8-2	0.25 ± 0.06	0.32 ± 0.01		
Dark orange	Pushu-32	0.57 ± 0.02	0.57 ± 0.06	0.37 ± 0.10	0.50 ± 0.13
Dark orange	Qianshu-5	0.53 ± 0.07	0.65 ± 0.08		
Dark orange	Taishu-14	0.34 ± 0.04	0.40 ± 0.07		
Dark orange	Sushu-14	0.34 ± 0.01	0.37 ± 0.01		
Dark orange	Ziyunhongxinshu	0.31 ± 0.07	0.32 ± 0.00		
Dark orange	Hongxiangjiao	0.28 ± 0.04	0.38 ± 0.08		
Yellow orange	Ecaishu-1	0.41 ± 0.01	0.61 ± 0.01		
Yellow orange	Quanshu-830	0.35 ± 0.01	0.42 ± 0.03		
Yellow orange	Qianshu-407	0.29 ± 0.03	0.50 ± 0.05		
Yellow orange	Wancaishu-19	0.27 ± 0.03	0.33 ± 0.05		
Light orange	Qianshu-18-5-4	0.42 ± 0.02	0.39 ± 0.02		
Light orange	Kaoshu	0.30 ± 0.05	0.36 ± 0.01		
Yellow	Qianshu-1	0.41 ± 0.00	0.45 ± 0.01	0.30 ± 0.08	0.42 ± 0.14
Yellow	Jishu-26	0.38 ± 0.04	0.40 ± 0.01		
Yellow	Pushu-53	0.38 ± 0.00	0.44 ± 0.00		
Yellow	Zhanjiangcaitaishu-71	0.33 ± 0.04	0.56 ± 0.07		
Yellow	Tongshu-2	0.30 ± 0.01	0.43 ± 0.05		
Yellow	Sushu-24	0.30 ± 0.02	0.38 ± 0.01		
Yellow	Qianshu-14	0.27 ± 0.06	0.34 ± 0.09		
Yellow	Anna	0.25 ± 0.02	0.45 ± 0.01		
Yellow	Wanshankaoshu	0.21 ± 0.01	0.19 ± 0.05		
Yellow	Chuanshu-1386-4	0.19 ± 0.03	0.86 ± 0.04		
Pale yellow	Qianshu-18-6-6	0.48 ± 0.04	0.57 ± 0.04		
Pale yellow	Xiangcaishu-2	0.45 ± 0.05	0.40 ± 0.01		
Pale yellow	Fushu-23	0.34 ± 0.03	0.42 ± 0.05		
Pale yellow	Huangyecaishu	0.30 ± 0.02	0.30 ± 0.01		
Pale yellow	Fushu-7-6	0.24 ± 0.14	0.38 ± 0.00		
Pale yellow	Qianshu-12	0.24 ± 0.03	0.43 ± 0.04		
Pale yellow	Nanshu-99	0.24 ± 0.01	0.37 ± 0.06		
Pale yellow	Wanshu-9	0.21 ± 0.012	0.32 ± 0.06		
Pale yellow	Qianshu-18-6-1	0.24 ± 0.02	0.34 ± 0.01		
White	Guangcaishu-3	0.36 ± 0.03	0.44 ± 0.02	0.31 ± 0.04	0.36 ± 0.10
White	Guangcaishu-5	0.36 ± 0.01	0.40 ± 0.02		
White	Qianshu-2	0.35 ± 0.01	0.54 ± 0.10		
White	Xiangshu-18	0.34 ± 0.02	0.54 ± 0.09		
White	Qianshu-11	0.32 ± 0.03	0.32 ± 0.03		
White	Chuancaishu-211	0.31 ± 0.05	0.31 ± 0.05		
White	Qianshu-18-5-2	0.29 ± 0.02	0.29 ± 0.02		
White	Qiancaishu-1	0.30 ± 0.02	0.30 ± 0.02		
White	Qiancaishu-2	0.29 ± 0.01	0.29 ± 0.01		
White	Fushu-18	0.27 ± 0.04	0.27 ± 0.04		
White	Zhanjiangxiyecaishu	0.28 ± 0.05	0.28 ± 0.05		
White	Xushu-18	0.21 ± 0.02	0.34 ± 0.05		
—	Vitamin C	0.97 ± 0.00	1.00 ± 0.00	—	—

others but also showed potential as antioxidant-rich varieties for dietary use. In a related research, Mohammad Alam et al. [38] investigated the mineral and vitamin C contents, along with the carotenoid composition (including β-carotene, α-carotene, lutein, lycopene, and β-cryptoxanthin), in nine varieties of orange-fleshed sweet potato (OFSP). His findings revealed significant variations in these critical nutrients across the studied OFSP varieties. Such variations highlight the nutritional diversity within sweet potato cultivars and underscore their potential health benefits, particularly in terms of vitamin and mineral intake.

Vitamin A deficiency is of public health significance in developing countries, causing temporary and permanent eye impairment and increased mortality. Due to the structural

Table 8: Sensory evaluation values of 48 sweet potato cultivars.

Cultivars	Bitterness	Fragrance	Sweetness	Smoothness	Texture	Score
Mianzishu-9	8.00	8.50	11.60	17.70	14.60	60.40
Qianshu-18-5-3	8.40	8.30	11.00	16.60	13.70	58.00
Ganshu-3	10.10	8.00	12.00	14.30	13.60	58.00
Jiheishu-1	9.00	8.90	12.10	17.60	14.50	62.10
Qianshu-18-8-2	11.80	10.4	14.20	19.20	18.60	63.80
Pushu-32	12.30	12.30	18.20	16.00	14.70	73.50
Qianshu-5	12.40	10.00	11.20	15.50	19.40	68.50
Taishu-14	12.20	7.900	13.60	15.40	15.70	64.80
Sushu-14	11.90	8.10	14.60	17.70	15.10	67.40
Ziyunhongxinshu	14.00	11.20	18.50	16.80	21.10	81.60
Hongxiangjiao	14.20	12.20	17.10	18.80	20.60	82.90
Ecaishu-1	13.30	11.30	14.90	16.70	18.90	75.10
Quanshu-830	13.20	10.30	12.20	18.20	15.30	69.20
Qianshu-407	12.40	10.10	14.70	16.90	14.10	68.20
Wancaishu-19	12.90	10.40	15.60	19.80	16.30	75.00
Qianshu-18-5-4	12.40	9.80	13.70	12.20	6.200	54.30
Kaoshu	12.90	10.40	15.60	19.80	16.30	75.00
Qianshu-1	14.20	9.80	17.20	18.40	14.50	74.10
Jishu-26	13.10	10.30	17.60	15.30	20.50	76.80
Pushu-53	12.10	12.00	13.70	21.40	18.30	77.50
Zhanjiangcaitaishu-71	11.40	9.70	12.20	14.80	13.50	61.60
Tongshu-2	12.20	10.00	13.50	21.80	14.50	72.00
Sushu-24	11.50	8.100	14.00	17.90	15.20	66.70
Qianshu-14	12.60	10.30	16.60	18.60	15.60	73.70
Anna	12.80	9.800	18.10	18.80	14.20	73.70
Wanshankaoshu	12.00	12.70	18.50	16.30	16.90	76.40
Chuanshu-1386-4	12.60	10.40	15.50	14.80	13.70	67.00
Qianshu-18-6-6	12.10	11.30	13.50	16.90	14.00	67.80
Xiangcaishu-2	11.70	10.10	17.60	13.20	13.30	65.90
Fushu-23	12.00	10.60	18.50	15.30	16.90	73.30
Huangyecaishu	12.30	9.80	13.10	13.60	14.40	63.20
Fushu-7-6	13.00	10.50	14.70	13.40	14.30	65.90
Qianshu-12	12.60	11.30	14.50	20.40	18.60	77.40
Nanshu-99	13.20	12.10	15.30	17.80	16.30	74.70
Wanshu-9	11.70	11.70	15.80	16.40	17.10	72.70
Qianshu-18-6-1	10.80	10.80	15.20	15.30	16.50	68.60
Guangcaishu-3	12.50	10.20	13.50	14.70	13.40	64.30
Guangcaishu-5	13.10	8.90	13.20	14.90	15.00	65.10
Qianshu-2	12.90	7.700	13.50	20.30	14.30	68.70
Xiangshu-18	12.90	10.10	10.90	18.00	19.50	71.40
Qianshu-11	14.40	11.10	10.00	18.10	19.20	72.80
Chuancaishu-211	12.30	9.40	12.70	14.20	17.50	56.70
Qianshu-18-5-2	11.90	10.30	12.50	12.80	15.50	63.00
Qiancaishu-1	13.30	9.900	10.60	19.00	19.30	72.10
Qiancaishu-2	12.90	8.700	12.20	13.20	14.00	61.00
Fushu-18	12.50	10.80	14.50	14.30	13.20	65.30
Zhanjiangxiyecaishu	12.00	10.00	11.60	14.20	11.50	59.30
Xushu-18	13.20	10.80	17.50	20.50	20.20	82.20

similarity, carotenoids can eliminate the symptoms of vitamin A deficiency. Sweet potato, especially orange and yellow flesh varieties, is an abundant source of carotenoids [39]. The carotenoids content in sweet potato was positively related to the color of flesh. The highest carotenoids content was recorded in dark orange flesh cultivars such as Pushu-32, Taishu-14, Sushu-14, and Qianshu-5. The average value of dark orange flesh varieties was 183.70 $\mu g \cdot g^{-1} \cdot DW$, followed by yellow orange flesh varieties (25.07 $\mu g \cdot g^{-1} \cdot DW$). Dark orange flesh cultivars such as Pushu-32 and Taishu-14, with its rich nutrient profile, could play a key role in reducing the hidden hunger for vitamins and antioxidants. This aligns with the findings of Tang et al. [40], who systematically compared the carotenoid profiles in both raw and cooked sweet potatoes across five varieties—white, yellow, orange, light purple, and deep purple. Tang et al.'s study revealed that yellow and orange varieties of sweet potato have higher carotenoid contents, particularly noteworthy given the essential role of carotenoids in human health as antioxidants and as precursors to vitamin A. These

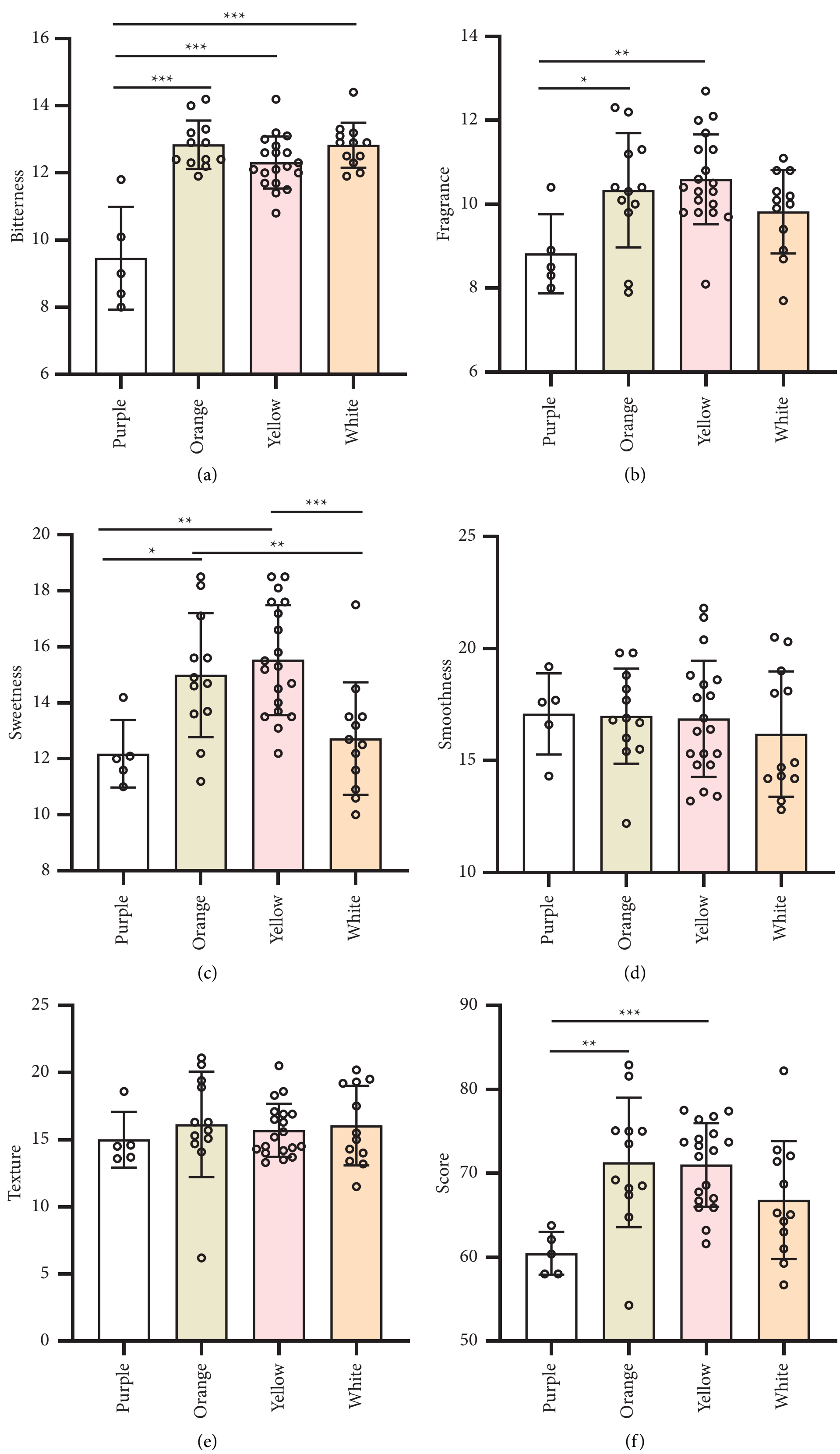

Figure 3: Sensory evaluation values of different color fleshed sweet potato. (a) Bitterness; (b) fragrance; (c) sweetness; (d) smoothness; (e) texture; (f) score. Data are expressed as the means ± SD, and the statistical differences were analyzed by one-way ANOVA. $^{*}P < 0.05$, $^{**}P < 0.01$, and $^{***}P < 0.001$.

Table 9: Correlation coefficient of TPC, caffeic acid derivatives, vitamin C, carotenoids, TAC (DPPH), and TAC ($ABTS^+$) in 48 sweet potato cultivars.

Traits	Chlorogenic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)	Caffeic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)	3,5-Dicaffeoylquinic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)	3,4-Dicaffeoylquinic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)	4,5-Dicaffeoylquinic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)	Vitamin C ($mg \cdot 100\, g^{-1} \cdot DW$)	TAC (DPPH) ($\mu g \cdot g^{-1} \cdot DW$)	TAC ($ABTS^+$) ($\mu g \cdot g^{-1}$ DW)
TPC ($\mu g \cdot g^{-1} \cdot DW$)	0.674*	0.147	0.706**	0.305*	0.678**	0.316*	0.546**	0.576**
Chlorogenic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)		0.360*	0.954**	0.378**	0.903**	0.516**	0.794**	0.767**
Caffeic acid ($\mu g \cdot 100\, g^{-1} \cdot DW$)			0.383**	0.026	0.433**	0.258	0.486**	0.169
3,5-Dicaffeoylquinic acid ($\mu g \cdot 100 g^{-1} \cdot DW$)				0.430**	0.917**	0.507**	0.809**	0.749**
3,4-Dicaffeoylquinic acid ($\mu g \cdot 100 g^{-1} \cdot DW$)					0.515**	−0.029	0.277	0.418**
4,5-Dicaffeoylquinic acid ($\mu g \cdot 100 g^{-1} \cdot DW$)						0.378**	0.768**	0.692**
Vitamin C (mg $100\, g^{-1} \cdot DW$)							0.487**	0.488**
Carotenoids ($\mu g \cdot g^{-1} \cdot DW$)							0.362*	0.052
TAC (DPPH) ($\mu g \cdot g^{-1} \cdot DW$)								0.601**

TAC, total antioxidant capacity; TPC, total polyphenol content. *Significant at 5% level. **Significant at 1% level.

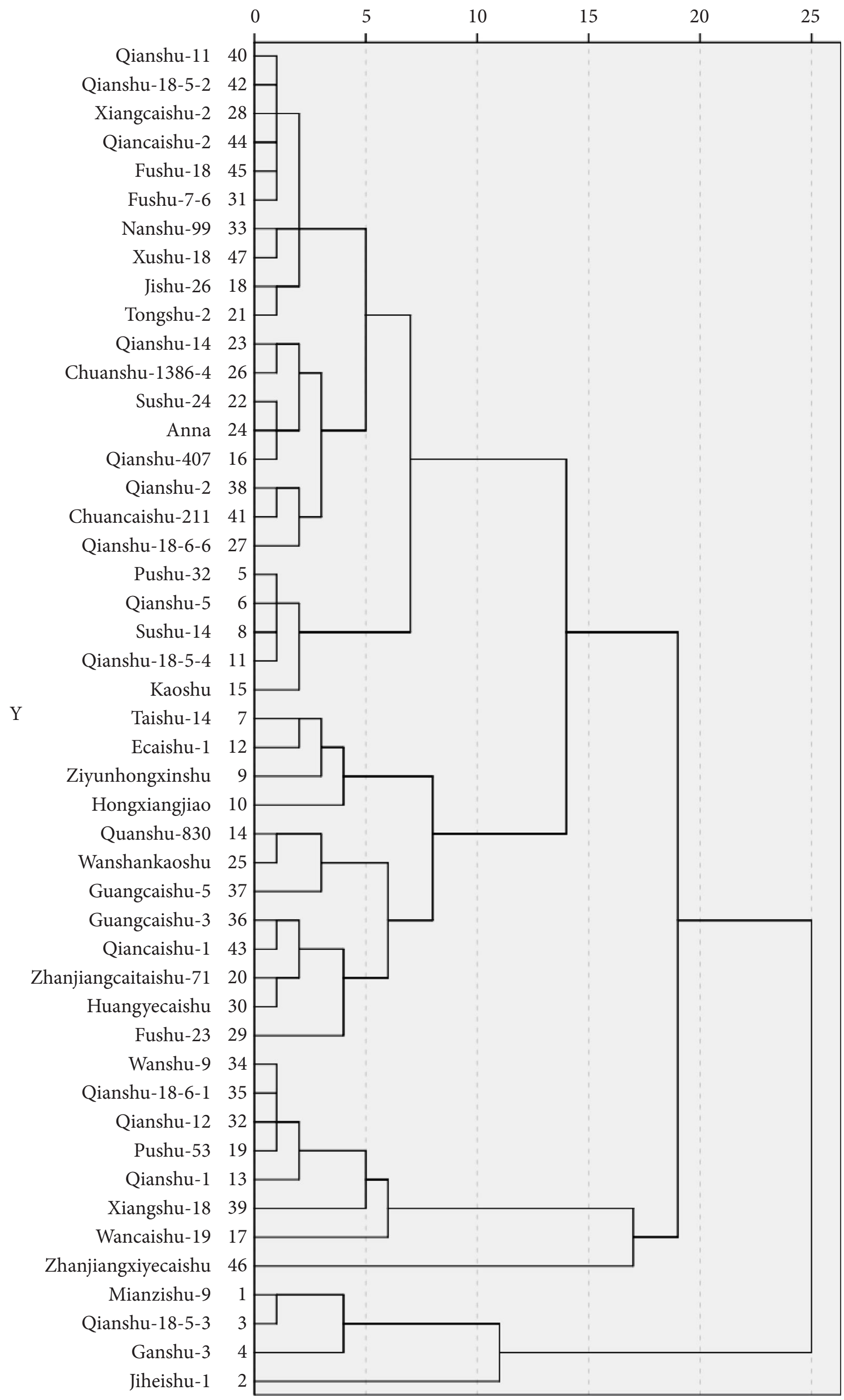

Figure 4: Cluster analysis of 48 sweet potato cultivars based on biological characters.

insights underscore the importance of selecting specific sweet potato varieties, like Taishu-14, in dietary strategies aimed at combating micronutrient deficiencies.

Sweet potato breeding programs must integrate sensory characterization and hedonic perception, including aspects such as taste, texture, aroma, and appearance, to deliver products that meet the diverse demands of global markets. In addition to considering proximate composition, functional phytochemicals, and bioactivity, the taste emerges as a pivotal factor for the acceptability of food products. Understanding and catering to these sensory preferences is the key to ensuring that these nutritionally rich crops are not only beneficial but also appealing to consumers worldwide. In the present study, albeit the purple-flesh varieties had abundant protein, starch, and antioxidants, they did not score high in sensory taste. The reason might be that the large amounts of polyphenols could increase the bitter taste [31] and the low water content influenced the texture. The dark orange flesh cultivars received the best average score among all genotypes. Dark orange flesh cultivars Hongxiangjiao and Ziyunhongxinshu were best for all sensory traits. Both cultivars were not abounding in starch, protein, and antioxidants. Hongxiangjiao had higher contents of protein, vitamin C, carotenoids, and phenolic acids and exhibited stronger antioxidative capacity than Ziyunhongxinshu. These cultivars might not suitable for staple foods, but they were recommended for people who have a desire for better flavor and taste.

Numerous investigations have suggested a positive effect on human health from the consumption of foods rich in bioactive substances with antioxidant activity, particularly phenolic compounds [41]. These compounds are known to reduce the risk of various diseases, including cancer, heart disease, and diabetes. Sweet potatoes, in this context, emerge as a valuable dietary choice due to their significant content of polyphenols. The presence of these compounds in sweet potatoes not only contributes to their antioxidant capacity but also positions them as a functional food with potential health-promoting properties. In a study conducted by Hana et al. [42], the antioxidant activity, total polyphenol content, and selected chlorogenic acids in different varieties of sweet potatoes were analyzed. The results suggested that the purple-fleshed variety of sweet potatoes possesses a significantly higher total polyphenol content, thereby exhibiting the highest antioxidant activity among the varieties tested. Similarly, our findings revealed that the chlorogenic acid, 3,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, and 4, 5-dicaffeoylquinic acid had positive and prominent relationship among each of them and with TPC and TAC ($ABTS^+$). All phenolic acids mentioned above, except 3,4-dicaffeoylquinic acid, were positively correlated to TAC (DPPH). It demonstrated that the increment of one phenolic acid was directly related to an increase of another phenolic acid. TAC ($ABTS^+$) had a significantly positive association with chlorogenic acid, 3,5-dicaffeoylquinic acid, 3,4-dicaffeoylquinic acid, 4, 5-dicaffeoylquinic acid, TPC, vitamin C, and TAC (DPPH). Carotenoids had a substantial positive correlation with TAC (DPPH). Vitamin C contributed to TAC ($ABTS^+$), chlorogenic acid, 3,5-dicaffeoylquinic acid, and 4, 5-dicaffeoylquinic acid as well. These findings revealed that polyphenols, carotenoids, and vitamin C were involved in the antioxidant capacity of sweet potatoes.

All these results can conform to the consequences from the total phenolic content and the total carotenoid content.

5. Conclusion

Sweet potato is a widely distributed root and tuber crop with great variability and phenotypic plasticity. Besides starch, sweet potato also provides protein, vitamin C, carotenoids, dietary fiber, and other natural antioxidants. Thus, sweet potato has a strong potential to prevent and improve mal- and undernutrition. In this study, 48 sweet potato varieties were comprehensively evaluated in terms of proximate compositions, phytochemicals, antioxidant activity, and sensory taste. It turned out that the chemical components and antioxidant activity differed markedly. These findings would contribute to the variety choice of sweet potato to meet the needs of different consumer groups in human food systems. For example, purple flesh cultivars with high starch, protein, and bioactive phytochemicals were encouraged to plant for improving malnutrition and combating hidden hunger. Cultivars with good taste were more suitable for enriching the diversity of food. The genotypes with high starch but low other ingredients could be used for flour processing.

Data Availability

The data used to support the findings of this study are included within the supplementary information file.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Yun Li provided the plant materials. Xi-You Li, Wei-Xi Li, and Xi Zhang were involved in the design of the study. Xi-You Li, Rong-Jiao Li, and Xin-Yu Ma conducted the experiments and analyzed all the data. Xi-You Li and Wei-Xi Li wrote the manuscript. Yun Li, Xi Zhang, and Wei-Xi Li checked and retouched the manuscript. All the authors have read and agreed with the manuscript.

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Supplementary Materials

The characteristics identified through investigation, such as the leaf shape, leaf color, potato skin color, and potato flesh color, are coded according to their morphological characteristics, as shown in the supplementary table. (*Supplementary Materials*)

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