

Supplementary Materials

Table S1. The protein content of different *Rubus* cultivars at different developmental stages.

| Cultivar | Period | | | | |
|--------------|--------------|----------------|--------------|---------------|-------------|
| | Green | Green-red | Red | Red-purple | Purple |
| Chester | 3.73±0.51aB | 3.05±0.20bA | 1.33±0.13dB | 1.39±0.22dA | 2.06±0.20cA |
| Hull | 2.92±0.56aC | 0.95±0.20bcCD | 0.46±0.16cD | 0.95±0.30bcB | 1.34±0.36bB |
| Boysen | 2.36±0.31aCD | 0.75±0.20cD | 0.83±0.15cCD | 1.06±0.06bcBC | 1.30±0.28bB |
| Young | 1.43±0.12aE | 1.03±0.24bcBCD | 0.92±0.27bcC | 1.24±0.06abBC | 0.86±0.20cB |
| Clode Summit | 0.94±0.22bE | Multicolor | Yellow | | |
| Heritage | 2.16±0.36aD | 1.36±0.11bB | 1.22±0.09bBC | 1.29±0.16bBC | |
| Bristol | 4.70±0.32aA | 1.17±0.19bcBC | 0.84±0.17cCD | 1.00±0.28bc | 1.34±0.27bB |

Note: Different lowercase letters (a–d) in columns denote significant differences between sampling dates for each cultivar fruits by Duncan's multiple range test ($p < 0.05$). Different capital letters (A–E) in columns denote significant differences by Duncan's multiple range test ($p < 0.05$) among different cultivars.

Table S2. Correlation of biologically active substances and antioxidant capacity in 'Chester' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .976** | 1 | | | | | | | |
| Soluble sugar | .964** | .911** | 1 | | | | | | |
| Vitamin C | -0.029 | -0.186 | -0.01 | 1 | | | | | |
| Vitamin E | -.738* | -.840** | -.695* | .672* | 1 | | | | |
| Flavonoids | -0.488 | -0.627 | -0.443 | .873** | .935** | 1 | | | |
| Anthocyanins | .975** | .945** | .990** | -0.112 | -.775** | -0.536 | 1 | | |
| Phenols | -0.354 | -0.475 | -0.377 | .919** | .862** | .957** | -0.461 | 1 | |
| DPPH | -0.502 | -.633* | -0.48 | .868** | .941** | .992** | -0.57 | .973** | 1 |

Note: “*” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). “**” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).

Table S3. Correlation of biologically active substances and antioxidant capacity in 'Hull' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .997** | 1 | | | | | | | |
| Soluble sugar | .999** | .995** | 1 | | | | | | |
| Vitamin C | -0.278 | -0.286 | -0.29 | 1 | | | | | |
| Vitamin E | -0.071 | -0.098 | -0.069 | .862** | 1 | | | | |
| Flavonoids | -0.441 | -0.471 | -0.435 | .778** | .900** | 1 | | | |
| Anthocyanins | .987** | .976** | .992** | -0.302 | -0.044 | -0.393 | 1 | | |
| Phenols | -0.473 | -0.48 | -0.481 | .947** | .866** | .896** | -0.487 | 1 | |
| DPPH | -0.499 | -0.504 | -0.508 | .962** | .821** | .842** | -0.518 | .989** | 1 |

Note: “*” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). “**” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).

Table S4. Correlation of biologically active substances and antioxidant capacity in 'Boysen' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .953** | 1 | | | | | | | |
| Soluble sugar | .938** | .866** | 1 | | | | | | |
| Vitamin C | 0.137 | 0.03 | -0.002 | 1 | | | | | |
| Vitamin E | -.731* | -.664* | -.891** | 0.343 | 1 | | | | |
| Flavonoids | -0.391 | -0.289 | -.677* | 0.384 | .854** | 1 | | | |
| Anthocyanins | 0.592 | 0.614 | 0.547 | -0.53 | -.664* | -0.306 | 1 | | |
| Phenols | -0.386 | -0.3 | -.676* | 0.368 | .853** | .993** | -0.265 | 1 | |
| DPPH | -0.338 | -0.223 | -.637* | 0.335 | .811** | .995** | -0.22 | .989** | 1 |

Note: “*” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). “**” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).

Table S5. Correlation of biologically active substances and antioxidant capacity in 'Young' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .991** | 1 | | | | | | | |
| Soluble sugar | .922** | .882** | 1 | | | | | | |
| Vitamin C | -0.57 | -0.616 | -0.472 | 1 | | | | | |
| Vitamin E | -0.475 | -0.43 | -.666* | 0.547 | 1 | | | | |
| Flavonoids | -0.268 | -0.222 | -0.507 | 0.483 | .970** | 1 | | | |
| Anthocyanins | .991** | .968** | .941** | -0.547 | -0.554 | -0.35 | 1 | | |
| Phenols | -.707* | -.640* | -.890** | 0.338 | .853** | .750* | -.777** | 1 | |
| DPPH | -0.58 | -0.526 | -.822** | 0.455 | .904** | .866** | -.636* | .919** | 1 |

Note: “*” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). “**” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).

Table S6. Correlation of biologically active substances and antioxidant capacity in 'Clode Summit' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .976** | 1 | | | | | | | |
| Soluble sugar | .977** | .981** | 1 | | | | | | |
| Vitamin C | .988** | .983** | .975** | 1 | | | | | |
| Vitamin E | -0.725 | -0.79 | -0.803 | -0.683 | 1 | | | | |
| Flavonoids | -0.357 | -0.461 | -0.491 | -0.315 | .899* | 1 | | | |
| Anthocyanins | .950** | .969** | .975** | .928** | -.902* | -0.627 | 1 | | |
| Phenols | -0.662 | -0.735 | -0.755 | -0.62 | .996** | .935** | -.861* | 1 | |
| DPPH | -.885* | -.914* | -.932** | -.851* | .949** | 0.731 | -.982** | .922** | 1 |

Note: “*” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). “**” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).

Table S7. Correlation of biologically active substances and antioxidant capacity in 'Heritage' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .975** | 1 | | | | | | | |
| Soluble sugar | .984** | .971** | 1 | | | | | | |
| Vitamin C | -0.507 | -0.554 | -0.421 | 1 | | | | | |
| Vitamin E | -.719* | -.771* | -0.643 | .908** | 1 | | | | |
| Flavonoids | -.725* | -.806* | -0.674 | .795* | .960** | 1 | | | |
| Anthocyanins | .930** | .911** | .969** | -0.205 | -0.453 | -0.508 | 1 | | |
| Phenols | -.810* | -.875** | -.767* | .788* | .959** | .990** | -0.612 | 1 | |
| DPPH | -.813* | -.875** | -.771* | .784* | .954** | .987** | -0.618 | .999** | 1 |

Note: "*" denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). "***" denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).

Table S8. Correlation of biologically active substances and antioxidant capacity in 'Bristol' fruits.

| | Fructose | Glucose | Soluble sugar | Vitamin C | Vitamin E | Flavonoids | Anthocyanins | Phenols | DPPH |
|---------------|----------|---------|---------------|-----------|-----------|------------|--------------|---------|------|
| Fructose | 1 | | | | | | | | |
| Glucose | .991** | 1 | | | | | | | |
| Soluble sugar | .979** | .957** | 1 | | | | | | |
| Vitamin C | .707* | .676* | .821** | 1 | | | | | |
| Vitamin E | .678* | .732* | 0.522 | 0.069 | 1 | | | | |
| Flavonoids | -0.368 | -0.294 | -0.52 | -.712* | 0.388 | 1 | | | |
| Anthocyanins | .847** | .824** | .775** | 0.302 | .729* | -0.152 | 1 | | |
| Phenols | -0.339 | -0.265 | -0.481 | -.636* | 0.385 | .993** | -0.172 | 1 | |
| DPPH | -.857** | -.823** | -.934** | -.925** | -0.268 | 0.599 | -0.565 | 0.529 | 1 |

Note: “*” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.05$). “**” denotes significant differences between various indicators by Duncan's multiple range test ($p < 0.01$).