The Difference of Amino Acid Profiling From Two Morphological Purple Sweet Potatoes From Kawi Mountain Cultivars, East Java, Indonesia

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Abstract. Indonesia is one of the main commercial producers of sweet potatoes. Previous study has presented well documented anthocyanin content of Purple Sweet Potatoes (PSP) from local cultivar in Indonesia. However, research about amino acids profiling of local cultivar PSP as high commodities in Kawi Mountain region has not undertaken. This study was explored amino acids profiles in two morphological PSP cultivated in Kawi Mountain region, Ngajum Village, Wonsari Subdistrict, Malang Regency, East Java, Indonesia. Fresh storage roots were cleaned with running water and shade dried. The analysis was conducted at PT. Saraswanti Indo Genetech, Bogor, Indonesia. Method of UPLC was used for identification of Ser, Glu, Phe, Ile, Val, Ala, Arg, Gly, Lys, Asp, Leu, Tyr, Pro, Thr, His, Cys and Met; while tryptophan was analyzed using HPLC method. The five largest amino acids in dark-purple skin and flesh PSP were Glu 565.75 mg/kg, Asp 479.74 mg/kg, Arg 413.54 mg/kg, Ala 371.87 mg/kg and Leu 336.67 mg/kg, whereas white flesh and purple skin PSP contained Glu 653.67 mg/kg, Asp 447.60 mg/kg, Arg 314.41 mg/kg, Lys 278.77 mg/kg and Leu 256.97 mg/kg. Future research is needed to investigate the health benefit of amino acids content in PSP from Kawi Mountain cultivar.

1. Introduction

Sweet potatoes (Ipomoea batatas (L.) Lam) is a Convolvulaceae family plants which are mainly originated from Central America countries. Currently, this plants widely cultivated around the world, both subtropical and tropical region including Indonesia [1]. Sweet potatoes are included into seven
most important crops in the world following wheat, rice, maize, potato, barley, and cassava. Sweet potatoes is also a major food crop in anumber areas of Indonesia[2].

The sweetpotato is a perennial plant grown vegetatively either by storage roots or stem cuttings. Storage roots are the most commercial part from this plant. There are various color differences from storage roots of PSP, ranging from white to dark purple. This color difference can be seen in both the skin and tuber flesh, depending on the amount and distribution of anthocyanin pigments[2].

Purple sweet potatoes (PSP) is one of the sweet potato varieties that has a dark-purple color both on the skin and tuber flesh. The range of anthocyanin content in raw storage roots of PSP are 107.8 mg to 174.7 mg/100 fresh weight [3]. Anthocyanin from PSP has a stronger antioxidant activity than anthocyanin contained in purple corn, grape skin, red cabbage and elderberry. Even the components of peonidin and cyanidin from PSP show a DPPH radical-scavenging activity that is stronger than ascorbic acid [4].

Indonesia has many varieties of local PSP cultivars that contain anthocyanin and benefits as antioxidants, antiapoptosis and neuroprotective [5-7]. In East Java province, PSP is a high commodities in the Gunung Kawi region[8][10]. Exploration of the health benefits potential of the Kawi Mountain cultivars of PSP were resulted in increasing superoxide dismutase enzymes, decreasing NF-kB and preventing the formation of foam cells in atherogenic diet [9, 10]. The same cultivars were also reported to optimally reduce caspase-3 and apoptosis at doses of 20 mg/kgBW although it had not significantly improved spatial memory ability in diabetic rats [11].

Besides the health benefit properties of local PSP, for our knowledge lack of research that reported amino acids (AA) content in local PSP cultivars. Though AA is very important as a precursor of various substances that function as a regulator of metabolism, growth, development in order to maintain whole body homeostasis [12]. Thus, the aim of this study was to explore the AA contain in PSP from Kawi Mountain cultivar.

2. Methods
2.1. Material
Fresh storage roots of PSP were collected from local agricultural areas in Ngajum village, Wonosari District, in Kawi Mountain, Malang Regency, East Java, Indonesia. We analyzed two different tuber morphologies of PSP, purple skin-flesh and purple skin-white flesh. The storage roots were then cleaned with running water and shade dried.

2.2. Research procedure
2.2.1. Ultra Performance Liquid Chromatography (UPLC)
All the procedure was carried out at PT.Saraswanti Indo Genetech, Bogor, Indonesia. Ultra Performance Liquid Chromatography method was used for identification 17 of amino acids e.g L-serine (Ser), L-glutamic acid (Glu), L-phenylalanine (Phe), L-isoleucin (Iso), L-valine (Val), L-alanine (Ala), L-arginine (Arg), glycine (Gly), L-lysine (Lys), L-aspartic acid (Asp), L-leucine (Leu), thyrose (Tyr), proline (Pro), threonine (Thr), histidine (His), cystine (Cys) and methionine (Met). In brief all procedure refered to Waters Acquity UPLC H Class and H Class Bio amino Acid Analysis System Guide [13]. The method was used column AccQ.Tag Ultra C18 1.7 μm (2.1 x 100 mm), with column temperature at 49°C, flow rates of mobile phase was 0.5 mL/minute, 1μl of injection volume andphotometric diode array (PDA) detector at 260 nm wavelength was used. Gradient composition systems of mobile phase were as followed A : Eluent A concentrate Amino Acid Analysis AccQ.Tag Ultra; B : Eluent B Amino Acid Analysis AccQ.Tag Ultra 10% in water; C : Aquabidest; D : Eluent B Amino Acid Analysis AccQ.Tag Ultra.

2.2.2. High Performance Liquid Chromatography (HPLC)
Tryptophan (Trp) was analyzed using High Performance Liquid Chromatography based on the AOAC official method. Lichrospher column RP-18, 250 mm x 4.0 mm, 5μm, Merck was used for separation, with ambient column temperatures. The mobile phase flow rate was 1.5 mL/min, isocratic pump
system, injection volume was 15 μL and photohometric diode array (PDA) detectors at 280 nm wavelength were used. The mobile phase consists of A = Sodium Acetate 0.0085 M pH 4; B = Methanol (A: B = 95: 5).

3. Results and Discussion
The results of the analysis showed that although there were differences in the morphology of the color of tuber flesh, the two types of PSP both contained 12 AA, namely Glu, Asp, Arg, Ala, Leu, Thr, Lys, Val, Phe, Ile, Pro and Tyr. While the other 6 AAs namely Gly, His, Cys, Met, Trp and Ser were not detected in both samples. Nevertheless there are still differences in AA levels from both samples for Glu, Ala and Thr wherein the purple-skin and white-flesh have higher level of Glu but lower level in Ala and Thr (Table 1).

Table 1. Comparison of AA content in two different morphological Purple Sweet Potatoes.

| Amino acids     | Purple skin and flesh (mg/kg) | Purple skin-white flesh (mg/kg) |
|-----------------|-------------------------------|---------------------------------|
| L-Glutamic acid | 565.74                        | 653.67                          |
| L-Aspartic acid | 479.74                        | 447.60                          |
| L-Arginine      | 413.54                        | 314.41                          |
| L-Alanine       | 371.87                        | <338.66                         |
| L-Leucine       | 336.67                        | 256.97                          |
| L-Threonine     | 292.33                        | <239.36                         |
| L-Lysine        | 279.28                        | 278.77                          |
| L-Valine        | 274.27                        | 190.01                          |
| L-Phenylalanine | 229.31                        | 210.53                          |
| L-Isoleucine    | 224.62                        | 162.93                          |
| L-Proline       | 223.25                        | 159.00                          |
| L-Tyrosine      | <222.88                       | <222.88                         |
| Glycine         | n.d                           | n.d                             |
| L-Histidine     | n.d                           | n.d                             |
| L-Cystine       | n.d                           | n.d                             |
| L-Methionine    | n.d                           | n.d                             |
| L-Tryptophan    | n.d                           | n.d                             |
| L-Serine        | n.d                           | n.d                             |

*n.d = not detected

Compared to other plants containing anthocyanin, blueberries and strawberries have lower Glu content, 14.35 mg/g and 61.99 mg/g, respectively. Conversely, the strawberries have highest level of Trp whereas Cys is highest in blueberries [14]. Another study conducted on Synsepalum dulcificum pulp berry reported that essential amino acids (EAA) were detected with the highest values coming from leucine 2.35 g/100 g of protein and methionine has the lowest value of 0.31 g/100 g of protein. Glutamic acid is the highest value of NEAA in Synsepalum dulcificum pulp berry [15]. Free Amino Acid (FAA) was also detected in three Rosa roxburghii Tratt fruit genotypes, both amino acids and non-essential amino acids with various levels [16].

Amino acids have traditionally been classified into essential amino acids and non-essential amino acids according to nitrogen balance. Essential amino acids cannot be synthesized either in animals or humans body, thus they are necessary to be consumed from foods. Non-essential amino acids can be synthesized in the body[17]. However, this classification has conceptual limitation because when there is an insufficient of NEAA synthesis, the body requires amino acid intake from food [18].

Methionine, lysine, histidine, leucine, isoleucine, phenylalanine, valine, threonine, and tryptophan are classified as essential amino acids. Whereas aspartate, alanine, arginine, glycine, cysteine, glutamate, proline, tyrosine, and serine are amino acids that not essential for humans and most other
animals[12]. However, some non-essential amino acids are classified as conditionally essential because the dramatically increase of demand, for example in pregnancy, infection, burns, injury, and breastfeeding [12]. Amino acids used by the body to synthesize various types of proteins that are important for physiological processes of the body, namely gene expression, cell growth, cell differentiation, hormone secretion, cell signaling, regulation of intestinal absorption, regulation of immune responses, etc[18].

The storage roots of PSP in the current study has glutamic acid as the highest value. Glutamic acid is well received as a conditional essential amino acid under conditions of stress and illness. Glutamic acid under physiological pH will be an anionic form called glutamate. Glutamate can also be synthesized into glutamine through the role of the glutamine synthetase enzyme[19]. Glutamate is an excitatory neurotransmitter in the central nervous system. Via glutamate receptors will mediate rapid synapse transmission. In addition glutamate is also needed in ammonia and protein metabolism, fetal-placental metabolism, maintenance of functions of the intestinal mucosal barrier, precursors of GABA neurotransmitters and others [20].

4. Conclusion
Current study revealed that purple sweet potatoes is a source of both essential or non-essential amino acid. In the future, further studies are needed to evaluate the health benefits of amino acids contained in purple sweet potatoes

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