

Research Article

Effect of Different Harvest Stages on Nutritional Components of Purple Yam

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Abstract: The effect of different harvest stages on nutritional components of purple yam had been studied in the open field. The results showed that the content of anthocyanins in purple yam tuberous root was the highest, while the content of dietary fiber and starch moderate during the first harvest stage; the content of anthocyanins, dietary fiber and starch began to decline during the second harvest stage; the content of all three gained some instead during the third harvest stage and the content of dietary fiber and starch was the highest; the content of β -carotene and selenium in purple yam tuberous root was stable during all harvest stages. In summary, the date between September 30th and October 15th which purple yam tuberous root containing higher levels of nutrients and is the best harvest stage.

Keywords: Anthocyanins, β -carotene, dietary fiber, purple yam, selenium, starch

INTRODUCTION

Chinese yams, also known as *Dioscorea batatas* Decne, belong to *Dioscorea opposita* Thunb which is a perennial or annual straggling herbaceous. Tingling or itching occurs if the slime exuded by yam tuberous root touches the skin. Yam is dioecious and cultivated as food or medicinal plant owing to its nutrient-rich cylindrical tuberous root. As the origins, China has a long history for cultivating yams. Currently, there are more than 600 varieties all over the world. Some species can nourish lungs and have ancillary effect for chronic enteritis, diabetes and nephropathy. Its high edible value and health value has been widely realized. In addition, it has become a vital export vegetable for both food and medicine in China (China Agricultural Encyclopedia Editors in Chief to Vegetable Roll Editor Committee, 1990) and has been extensively cultivated in the provinces of Zhejiang, Shandong, Guangdong, Fujian, Jiangxi and Taiwan (Chai *et al.*, 1999).

The existing system of Chinese yam classification is still no uniform standard but species. According to relevant research, the species generally is classified into three groups-white flesh, yellowish flesh and purple flesh (Chai *et al.*, 1999). As seen from this, the purple yam is belonging to the third group. The purple yam tuberous root is fusiform or cylindrical with tender flesh and puce skin (Zhao *et al.*, 2009), which particularly rich in amino acid-eighteen amino acids include all eight of the essential-as well as containing more dietary fiber than regular (Yu *et al.*, 2010). Besides that, purple yam also has large amount of

anthocyanins and selenium which can protect organisms from damage, delay the aging process of the body and strengthen immunity and antimutation by scavenging free radicals and stopping lipid peroxidation after absorbed into the body (Zhao and Zhang, 2005; Wan *et al.*, 2004; Huang *et al.*, 2004). The edible, medicinal and healthy values of purple yam have been appreciated by people gradually, which makes purple yam become the most potential choice for Chinese yam cultivation. However, the formation and accumulation of dietary fiber, anthocyanins and selenium partly influenced by environmental factor such as light, temperature and moisture those change with climate particularly after tuberous root form in the production. The text included effect of different harvest stages on nutritional components of purple yam, aimed to determine the best harvest stage of purple yam.

MATERIALS AND METHODS

Experiment material and design: Purple yam seed was offered by Shandong Weifang Weifeng Agricultural Products Co., Ltd. in spring 2012 and promoted seed germination under favorable circumstances in April 2012. Planted the seed in trench (depth 0.3 m, wide 0.6 m, space 2 m), in the experimental field at Qingdao Agriculture University (N36.32° E120.39°) in May 2012. Experiment areas were 150 m² (10×15 m) and adopted common ways of cultivation and management. Divided harvest stage into three stages and harvested 5 plants (both aboveground and underground) every turn. The first stage is

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September 30 (Stage 1, S1); the second stage is October 15 (Stage 2, S2); the third stage is October 30 (Stage 3, S3). Cut purple yam up in 0-1 mm thin slice and fixed it at 105°C for 30 min after harvest, then baked to constant heavy. Crushed it by plant mill and refrigerated in zip-lock bags.

Determination project and method: Anthocyanin was measured by extraction method. Dissolved 2.00 g sample in 20 mL ethanol-citric acid mixture (99:1), then extracted it shielded from light for 24 h. Determined it by TU-1810SPC UV spectrophotography after filtering and concentrating.

β -Carotene was measured by grinding extraction. Added 1.00 g sample, a few of quartz sand and 3 mL absolute alcohol-petroleum ether mixture (1:9) in mortar, grinded and extracted until no yellow. Transferred the extract and 70-80 mL water in separatory funnel, then separated petroleum ether in 25 mL colorimetric tube and brought to volume by absolute alcohol-petroleum ether mixture. Determined it by TU-1810SPC UV spectrophotography.

Selenium was measured by atomic fluorescence spectrometry. Accurately weighted 0.50 g sample and heated it at 160°C until 1 mL left, which was dissolved in 10 mL perchloric acid-nitric acid mixture (1:4). Transferred solution to 25 mL volumetric flask and brought to volume by deionized water and then determined it by AFS-920 atomic fluorescence spectrometry instrument.

Dietary fiber was measured by GB/T 5009.88-2008.

Starch was measured by GB/T 5009.9-2008.

RESULTS AND DISCUSSION

Effect of different harvest stages on the content of anthocyanins in purple yam: Figure 1 indicated that the content of anthocyanins in purple yam tuberous root reached the highest level during the first harvest stage, which then began to decline during the second harvest stage but increased slightly during the third harvest stage. Probably due to wilting of aboveground and more nutrients had been transferred from the stems and leaves to tuberous root during the later period of harvest stage. Figure 2 indicated that as time goes on, the content of anthocyanins in aboveground, which higher than underground, was decreased obviously.

Effect of different harvest stages on the content of β -carotene in purple yam: As illustrated in Fig. 3, the content of β -carotene in purple yam tuberous root maintained a relatively lower level and displayed initial ascending and then descending tendency which reached the highest during the second harvest stage. Figure 4 showed that the content of β -carotene in aboveground

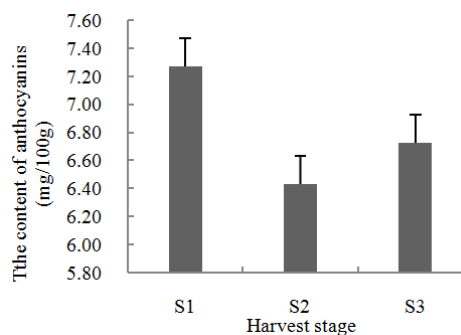


Fig. 1: The content of anthocyanins in tuberous root

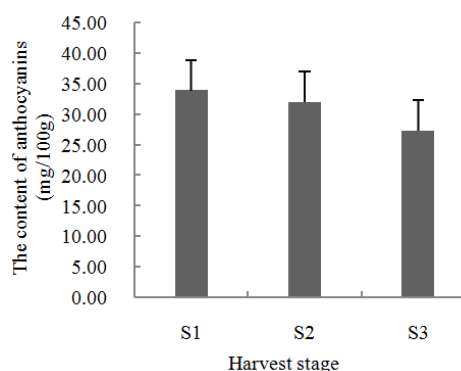


Fig. 2: The content of anthocyanins in aboveground

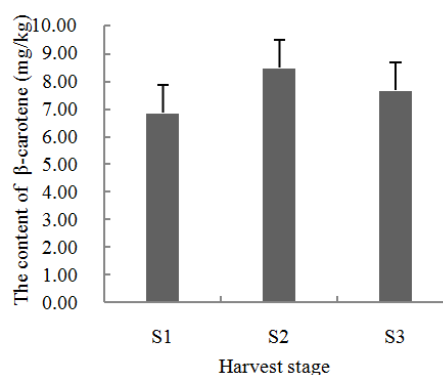


Fig. 3: The content of β -carotene in tuberous root

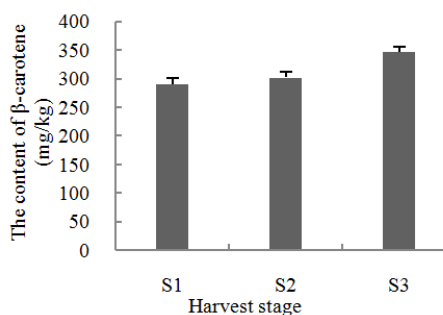


Fig. 4: The content of β -carotene in aboveground

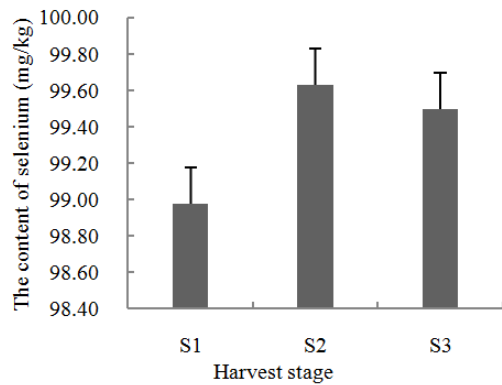


Fig. 5: The content of selenium in tuberous root

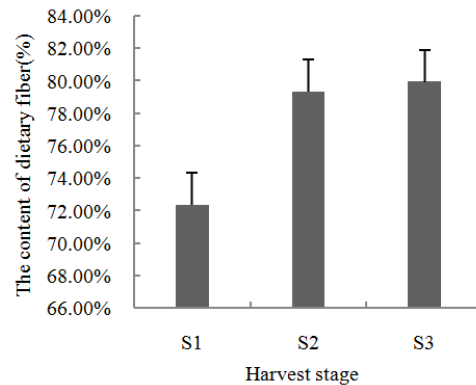


Fig. 8: The content of dietary fiber in aboveground

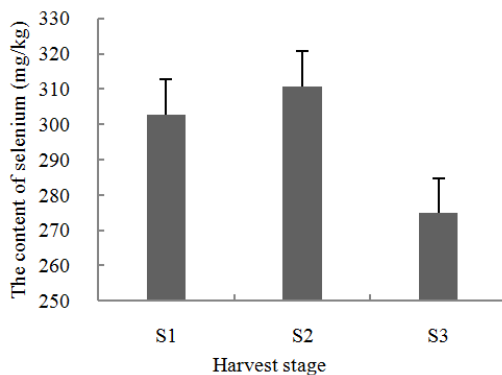


Fig. 6: The content of selenium in aboveground

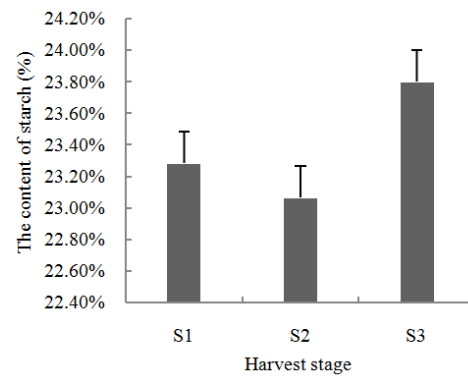


Fig. 9: The content of starch in tuberous root

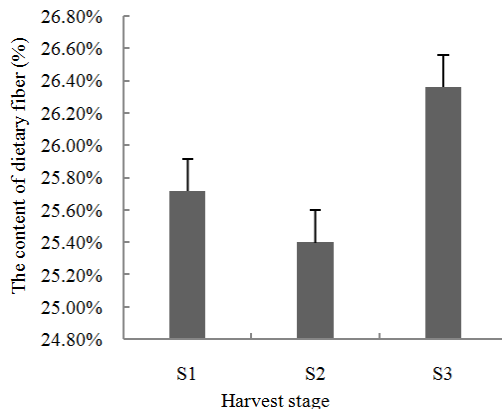


Fig. 7: The content of dietary fiber in tuberous root

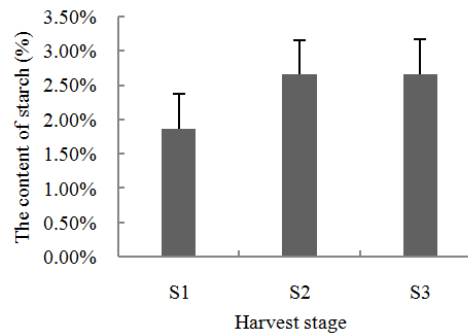


Fig. 10: The content of starch in aboveground

was as much 40 times as tuberous root and appeared a rising trend over time.

Effect of different harvest stages on the content of selenium in purple yam: In Fig. 5, the content of selenium in purple yam tuberous root is far more stable than other nutrients and there was no significant difference between every stage. The trend of it increased firstly and then decreased that lowest during

the first harvest stage and reached the highest during the second harvest stage. As showed in Fig. 6, the content of selenium in aboveground had the same trend with tuberous root, which may due to wilting of aboveground and decomposition of protein during the later period of harvest stage.

Effect of different harvest stages on the content of dietary fiber in purple yam: In Fig. 7, dietary fiber accounts for more than 25% of tuberous root, which achieved the highest during the third harvest stage and had no significant difference with other stage. Figure 8

indicated that the content of dietary fiber in aboveground presented a gradual upward trend, had certain relationship with moisture decrease of aboveground.

Effect of different harvest stages on the content of starch in purple yam: In Fig. 9, the content of starch in tuberous root achieved highest during the third harvest stage experienced the process of descending first and then ascending. Illustrate those nutrients in aboveground dissolved and transferred to tuberous root for starch biosynthesis during the later period of harvest stage. Figure 10 indicated that the content of starch in aboveground increased uninterrupted, mainly due to moisture decrease and wilting of aboveground.

CONCLUSION

Biosynthesis and accumulation of anthocyanins, mainly controlled by both growth and development of plant, are also subject to internal and external factors. It has been illustrated by research at home and abroad that environmental factors, such as light, temperature and moisture, can modify the biosynthesis of anthocyanins by influence expression of gene of plant actually (Biran and Halevy, 1974; Mori *et al.*, 2005; Islam *et al.*, 2005). Therefore, accumulation of anthocyanins correlatively also reflects effect of environmental factors of different stages on biosynthesis of organic matter of plant. Besides, the content of saccharides of plant also influence the accumulation of anthocyanins, for instance, biosynthesis of anthocyanins can be increased dramatically with sugar (Solfanelli *et al.*, 2006). Consequently, the content of anthocyanins is yet another manifestation of the content of other nutrients such as saccharides. The experimental results showed that the content of anthocyanins in tuberous root were decreased at first and later increased. It may due to the alteration of environmental factors, such as light diminishing, temperature decrease and moisture reduction, which were unfavorable for biosynthesis of anthocyanins during the second harvest stage and nutrients transferred from aboveground to tuberous root which increased the accumulation of anthocyanins during the third harvest stage.

β -Carotene, contain four pentadiene, is terpenoids which high reactivity for its high unsaturation caused by active chemical property. It has been reported that high temperature easily leads to decomposition of β -carotene (Song *et al.*, 2011). The experimental results showed that β -carotene began to increase during the second harvest stage which temperature reduces. Demonstrated that the increase of β -carotene cause by both the reduction of temperature which slowed decomposition of β -carotene and aboveground moisture decrease continuously in the later period of harvest.

The information available at present showed that the content of selenium in regular yam tuberous root is

about 0-40 mg/kg (Ye, 2012). The result showed that the content of selenium in purple yam tuberous root is as twice as the regular. In addition, Selenoprotein, an essential protein, is selenium in the form of selenocysteine participates in the formation of protein (Huang *et al.*, 2001). The reduction of selenium in both aboveground and tuberous root after the second harvest stage illustrated that decomposition of selenoprotein under environmental factors change lead to selenium decrease.

Dietary fiber include cellulose, lignin, waxy, chitin, pectin, β -dextran and oligosaccharide, those are generally divided into two types-soluble dietary fiber and insoluble dietary fiber (Liu *et al.*, 2006). The result showed that the purple yam had the higher nutrition cause of its massive pectin and cellulose was higher than the regular especially in the later period of harvest stage. However, other research showed that yam tuberous root starch accounts for 16-20% of fresh weight (Meng and Zhao, 2008). As result showed that purple yam tuberous root starch accounts for less than 24% of dry weight, illustrated the content of starch in purple yam was lower than the regular.

As the result showed that the content of anthocyanins, easily destroyed by environmental factors, in purple yam tuberous root was highest during the first harvest stage and then reduced to the lowest during the second harvest stage; the content of β -carotene and selenium had the same trend, increased in advance then felled, during all harvest stages; the trend of dietary fiber was accord with starch, achieve the highest during the third harvest stage. Compared with regular yam, purple yam contains anthocyanins, β -carotene and selenium which have strong antioxidant capacity. Furthermore, purple yam contains large amount of nutritious and medical element could be used to improve immunity. Consequently, the date between September 30th and October 15th is the best harvest stage for more nutritious.

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