STARCH CONTENT OF TUBER OF SOME CASSAVA VARIETIES IN SOME LEVEL TIME OF STORAGE AND ITS YIELD

Sholihin

Cassava plant breeder, Indonesian legume and Tuber Crops Research Institute (ILETRI), Jl. Raya Kendalpayak Km-8, Pakisaji Malang, E-mail: sholhalim@yahoo.com

ABSTRACT

The aim of the study was to evaluate the starch content of tuber of some cassava varieties/clones in the time level of storage and its yield. For evaluation of the starch content of tuber of some cassava released varieties in the time level of storage, the experiments were done in Malang in 2008. The experiments were done using a RCBD, two factors. First factor was level time of storage (0; 2; 4; 6) days after harvesting, three replications. Second factor was a total 9 clones/ varieties. Three replications were used in this experiment. The tuber from the plants harvested in 10 months. For yield evaluation, the experiment was done in was done in Malang in 2008. The testing was done using a RCBD, three replications. A total 9 clones were tested in this experiment. The plot size was a 5 m x 5 m.

The result of evaluation of the starch content of tuber of some cassava released varieties in the time level of storage can be seen that the clones x the level times of storage Interaction was different significantly for starch content. The starch content of tuber of MALANG 4, CMM 97006-44, MALANG 6, DARUL HIDAYAH, MALANG 1, and CMM 97007-145 were not significantly decreased in 2 days after harvesting, while the starch content of tuber of ADIRA 1, UJ5, and L. NGANJUK were significantly decreased in 2 days after harvesting, 5%, 10%, and 6% respectively. In 4 days after harvesting, the starch content of tuber of CMM 97006-44, MALANG 6, MALANG 1, and DARUL HIDAYAH were not significantly decreased, but the starch content of tuber of MALANG 4, ADIRA 1, UJ5, L. NGANJUK, and CMM97007-145 were significantly decreased 6%, 5%, 10%, 6% and 4% respectively. The starch content of tuber of CMM 97006-44, and DARUL HIDAYAH were not significantly decreased in 6 days after harvesting, while the starch content of tuber of MALANG 4, MALANG 6, ADIRA 1, UJ5, MALANG 1, L. NGANJUK, and CMM97007-145 were significantly decreased in 4 days after planting, 12, 6, 6, 14, 8, 6, and 6 %, respectively. The result of yield evaluation can be seen that the average of tuber yield of MALANG 6 was the highest. Fresh tuber yield of MALANG4, ADIRA 4, MALANG1, CMM97007-145, and CMM97006-4 were equel to MALANG 6. DARUL HIDAYAH, UJ5, and ADIRA1 were significantly lower than MALANG 6.

Keywords: cassava, starch content, storage, variety

ABSTRAK

Kandungan pati beberapa varietas/klon ubikayu pada berbagai tingkatan waktu penyimpanan dan hasilnya. Penelitian bertujuan untuk mengevaluasi kandungan pati beberapa varietas/klon ubikayu pada berbagai tingkatan waktu penyimpanan. Penelitian dilaksanakan di Malang pada tahun 2008, menggunakan rancangan acak kelompok dalam faktorial. Faktor I adalah waktu penyimpanan: 0, 2, 4, dan 6 hari setelah panen. Faktor II adalah varietas/klon ubikayu. Untuk evaluasi

hasil, percobaan dilaksanakan di Malang pada tahun 2008, menggunakan rancangan acak kelompok, tiga ulangan. Dalam percobaan ini digunakan 9 klon/varietas ubikayu. Ukuran plot 5 m x 5 m. Terdapat interaksi antara varietas/klon dengan waktu penyimpanan untuk kandungan pati. Kandungan pati umbi pada penyimpanan dua hari setelah panen pada varietas/klon MALANG 1, MALANG 4, MALANG 6, CMM 97006-44, DARUL HIDAYAH, dan CMM 97007-145 tidak nyata menurun, sedangkan pada varietas/klon ADIRA 1, UJ5, dan L. NGANJUK menurun secara nyata, masing-masing sebesar 5%, 10%, dan 6%. Pada penyimpanan 4 hari setelah panen, kandungan pati umbi varietas/klon MALANG 1, CMM 97006-44, DARUL HIDAYAH, dan MALANG 6 tidak nyata menurun, namun varietas/klon MALANG 4, ADIRA 1, UJ5, L. NGANJUK, dan, CMM 97007-145 menurun secara nyata, masing-masing sebesar 6%, 5%, 10%, 6%, dan 4%. Kandungan pati umbi klon/varietas CMM 97006-44 dan DARUL HIDAYAH tidak nyata menurun pada penyimpanan enam hari setelah panen, sedangkan pada varietas/klon MALANG 1, MALANG 4, MALANG 6, ADIRA 1, CMM 97007-145, UJ5, dan L. NGANJUK menurun secara nyata masing-masing sebesar 12%, 6%, 6%, 14%, 8%, 6%, dan 6%. Di antara varietas/klon yang dievaluasi, MALANG 6 mempunyai hasil yang tertinggi, sedangkan, MALANG 1, MALANG 4, CMM 97007-44, dan CMM 97007-145 setara dengan DARUL HIDAYAH, UJ5, dan ADIRA 1.

Kata kunci: ubikayu, kandungan pati, penyimpanan, varietas

INTRODUCTIONS

Starch content is important parameter for breeder, businessman, and farmer. In the big starch factory, starch content is considered in determine the price of tuber. The tubers with high starch content are more expensive than those with low starch content. For breeder, starch content is used as the basis in selection and evaluation. For the farmers which sell the tuber to the starch factory, they want high starch content.

Starch content is determined by genetic and environment factor, including plant maturity (Soenarjo and Hardono 1986). Generally, starch content will increase till certain point, if plant maturity increases. There is positive correlation between starch content and total rainfall in 6-9 months after planting, however, in 1 or 2 months before harvesting, it is negative correlation (Howeler 2001). Sholihin and Sundari (2007) reported that the effect interaction between clones and environment was significant for starch content in 9 months after planting.

For ethanol production, starch content of tuber is important. Result of biplot analysis of data reported by Ginting *et al.* (2006) can be seen that starch content was negative correlation with the value of conversion of tuber to ethanol (r=-0,68*). It means that the tubers with high starch content are more effective than the tuber with low starch content.

In some starch factory, it is difficult to process the tuber directly after harvesting. Usually some farmer storage the tuber one day after harvesting before selling to the starch factory. And in some starch factories, the tubers are stored in few days before the processing of the tuber. The question comes out how long the tuber can be store before the processing of the tuber. Broto and Richana (2007) reported that the tuber will be damaged and starch content will

be changed in 2 days after harvesting. Aryee *et al.* 2006 reported that root of cassava start to deteriorate within two to three days after harvest if not processed. Processing is undertaken primarily to detoxify the cassava product to improve it palatability and to convert it into storable form. The aim of the experiment was to evaluate the starch content of tuber of some cassava released varieties in the time level of storage and its yield.

MATERIALS AND METHODS

For evaluation of the starch content of tuber of some cassava released varieties in the time level of storage, the experiment was done in Malang in 2008. The experiments were done using a RCBD, two factors. First factor was level time of storage (0; 2; 4; 6) days after planting, three replications. Second factor was a total 9 clones/varieties. Three replication were used in this experiment. The tuber from the plants harvested in 10 months. Tubers were put in the bag in air temperature. Starch content was measured based on specific gravity. Starch content was calculated as follows:

First calculate SG (specific gravity) = (fresh tuber weight in the air)/ (fresh tuber weight
in the air-fresh tuber weight in the water)
Second, calculate starch content = SG x 112.1-106.4

Data of starch yield were analyzed using MSTATC program to get the analysis of variance. For yield evaluation, the experiment was done in Malang in 2008. The testing was done using a a RCBD, three replications. A total 9 clones were tested in this experiment. The plot size was a 5 m x 5 m.

RESULTS AND DISCUSSIONS

The analysis of variance for 9 clones/varieties and 4 level time of storage was given in Table 1. The clones x level time of storage interaction was different significantly for starch content. Other words, resistance of tubers for storage were different for one clone to another clone.

Table 1. ANOVA for 9 cassava clones/varieties and 4 level time of storage

Source	Df	MS
Replication	2	0.086
Storage (S)	3	10.685**
Clones (C)	8	9.696**
C x S	24	0.798**
Error	70	0.262
CV (%)		3

** : significantly at 1%.

On Table 2, it can be seen that the starch content of tuber of Malang 4, CMM 97006-44, Malang 6, Darul Hidayah, Malang 1, and MLG 97007-145 were not

significantly decreased in 2 days after harvesting, while the starch content of tuber of Adira 1, UJ5, and L. Nganjuk were significantly decreased in 2 days after harvesting, 5, 10, and 6% respectively. UJ5 is released variety which is highest starch content between released varieties (Sholihin 2008), this variety has disseminated in Lampung. Tuber of this variety should be processed as soon as possible after harvesting, because two days after harvesting, the starch content decrease 10%. The starch content of tuber of CMM 97006-44, Malang 6, Malang 1, and Darul Hidayah were not significantly decreased in 4 days after harvesting, while the starch content of tuber of Malang 4, Adira 1, UJ5, L. Nganjuk, and CMM97007-145 were significantly decreased in 4 days after harvesting, 6, 5, 10, 6 and 4% respectively. The starch content of tuber of CMM 97006-44, and Darul Hidayah were not significantly decreased in 6 days after harvesting, while the starch content of tuber of Malang 4, Malang 6, Adira 1, UJ5, Malang 1, L. Nganjuk, and CMM97007-145 were significantly decreased in 6 days after harvesting, 12, 6, 6, 14, 8, 6, and 6%, respectively. So there were differences characteristic each clones, some clone, its starch content decreased in two days harvesting, some clones, its starch content decreased in 4 days, some clones, its tuber decreased in 6 days, and some clones, its starch content did not decreased in 6 days. Decreasing of starch content in few days after harvesting is because of the existing of primary deterioration and secondary deterioration.

The primary deterioration is an endogenous physiological process called vascular streaking which results in a fine blue-black or brown discoloration. The physiology and biochemistry of primary deterioration has involves increase activity of various enzymes, production of catechin and coumarin components including scopoletin, scopolin and esculin and of other metabolites (Rickard 1985). Physiological deterioration caused a reduction in the β-carotene content of golden yellow cassava (Gloria and Uritani 1984). It is followed by secondary deterioration which involves microbial rotting or sometimes softening or fermentation of the tissue (Rickard and Coursey 1981 *in* Bradbury and Holloway 1988). Mechanical damage to the root during and after harvesting is significant in causing primary deterioration and in facilitating secondary deterioration. This may be reduced by the process of curing which involves exposure of the tubers to about 35 °C at 80-85% RH.

There are some methods by which it is possible to improve the storage of tuber. First, by to leave the tuber in the ground until needed. Second, pruning all the branches from the plants up to 3 weeks before harvest causes changes to occur in the tuber which improves storage (Rickard and Coursey 1981 *in* Bradbury and Holloway 1988.) Third, by packing tubers in moist sawdust in boxes for reducing the exposure of tuber to air and reducing moisture loss (Booth *et al.* 1976). Fourth, by storing the tubers in clamps or interlayering between cassava leaves or coating tubers with wax. Fifth, by storing tubers in cold storage at 3°C. Sixth, by storing the tubers samples stored in the deep freeze at -20 °C. It appear stable for long periods, although over 6-8 months storage bound cyanide (linamarin) is broken down and appears as free cyanide (Bradbury and Holloway 1988).

There are some changes during storage of tuber. There is conversion of starch to sugar. Booth *et al.* (1976) reported that conversion of starch to sugars such that the sugar content was two to three times its original level after 2 weeks of storage. Pillai *et al.* (1970) also reported that an increase in sugar and decreased in starch on storage of tubers in soil. Kawabata *et al.* (1984) found an increase in the amounts of glucose and fructose and a decrease in the amount of sucrose during storage at ambient temperature. Beside that, softening of the central part of the tuber also occurs.

As mention before, there were differences characteristic each clones in related to starch content of tuber after storage, it indicate that deterioration of each clones is different. So there is the possibility to do breeding activity for the deteriorate aspect. CIAT (2008) reported that an interspesific cross between Manihot esculenta and M walkerae produced a material whose roots did not deteriorate, even as long as 3 weeks after harvesting.

Until now, there are ten released varieties, however, those varieties have never tested in the time in the same place. Seven released varieties and other promising clones have tested in Malang in 2008. The analysis of variance for tuber yield is given in Table 3. The clones was significantly difference for tuber yield. The tuber yield was presented on Table 4. The average of tuber yield of MALANG 6 was the highest. Fresh tuber yield of MALANG 4, ADIRA 4, MALANG1, CMM97007-145, and CMM97006-4 were equel to MALANG 6 (Table 4). DARUL HIDAYAH, UJ5, and ADIRA1 were significantly lower than MALANG 6. Tuber yield of DARUL HIDAYAH was so different from the tuber yield as reported by Suhartina (2005), 101 t/ha. This differences was also reported by Sholihin *et al.* (2004). So the users should consider this result before planting DARUL HIDAYAT in wide scale.

Table 2. Starch content of some clone in 4 level time of storage

Clones/varieties	Starch content (%)			
	0 day after harvesting	2 days after harvesting	4 days after harvesting	6 days after Harvesting
1. MALANG4	22.1	22.0	20.7	19.5
2. CMM97006-44	20.5	19.8	20.0	20.1
3. MALANG6	21.1	20.8	20.8	20.0
4. DARUL	20.8	20.0	20.5	20.4
5. ADIRA1	20.1	19.1	19.0	18.8
6. UJ5	24.3	21.9	21.9	20.8
7. MALANG1	21.1	20.6	20.4	19.3
8. L.NGANJUK	20.4	19.1	19.1	19.2
9. CMM97007-145	21.9	21.1	21.0	20.5
mean	21.4	20.5	20.4	19.8
LSD 5%	0.8	0.8	0.8	0.8
CV (%)	2	2	2	2

Table 3. ANOVA of tuber yield for 9 cassava clones/varieties

Source	Df	MS
Replication	2	687**
Clones (C)	8	151**
Error	16	38
CV (%)		15

** : significantly at 1%.

Table 4. Tuber yield of some clones in Malang, 2008.

clones	Tuber yield (t/ha)
1. MALANG 4	46.46
2. CMM97006-44	41.46
3. MALANG6	49.65
4. DARUL	33.54
5. ADIRA1	28.82
6. UJ5	33.13
7. MALANG1	39.10
8. CMM97007-145	39.79
9. Adira 4	47.08
mean	39.89
LSD 5 %	10.67

CONCLUSION

1. In general, storage 2 days after harvesting, starch content of cassava was not decreased significantly. However, starch content of Malang 4, CMM 97006-44, and Darul Hidayah were not decreased significantly after 6 days after harvesting.
2. The tuber yield of Malang 6, Adira4, and Malang 4 were 49.65; 47.08, and 46.46 t/ha, respectively, signifiacantly higher than Darul Hidayah.

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