The Behavior of Moisture Content in Durian after Harvesting by Neutron Reflection and Transmission Techniques.

T. Chimoye and M. Fuangfoong

Faculty of Science and Technology,
Thammasat University, Rangsit Campus, Pathumthani, Thailand.

Abstract

Durian have been exported during these past several years. The quality of Durian is very important but the method to check its quality still not reliable. The old tradition to check the quality is the counting time after blossom method. The main factor that influents to the quality of Durian is the moisture content which decreases with time during its growth and also after harvested. The propose of this study is to study about the moisture content after harvesting by using Neutron Reflection and Transmission technique. From the test results, it was found that these techniques can be used to study the behavior of the moisture content in Durian, which correspond with the weighting method.

Introduction

Durian is one of exported fruits of SouthEast Asia Countries, such as Indonesia, Malaysia and Thailand. For Thailand, fresh Durian earned about 800 million Baht per year [1,2]. There are more than 100 clones available in this region out of which only a small number is utilized by the farmer. In Thailand, the popular clones are Kop, Chanee, Kan Yau and Man Thong. The typical characteristics are round to oval in shape, green to brownish green in color and the flesh is golden yellow, soft and sweet as shown in Figure 1. The quality of Durian depends on the moisture content, which is about 64.1% for edible portion [3]. It was predicted that the moisture content of Durian decreased with time during its growth and also after harvesting as shown in Figure 2. Although Durian has been exported for more than decades but the standard to check its quality was not established yet. The old tradition method is counting time method. The period of about 95-120 days after blossom, which depends on the clone and planting place, is needed before the harvesting. After harvested, the waiting period is about 7-14 days, which depends on temperature and humidity of the environment, before it can be consumed. The other techniques are hearing the different sound when hit it and smelling its smell. In this study, the Neutron Reflection and Transmission techniques [4,5,6] were adapted. A system of a 3 mCi Am-Be neutron source by using BF_3 detector as the neutron probe was developed to determine the moisture content in Durian.

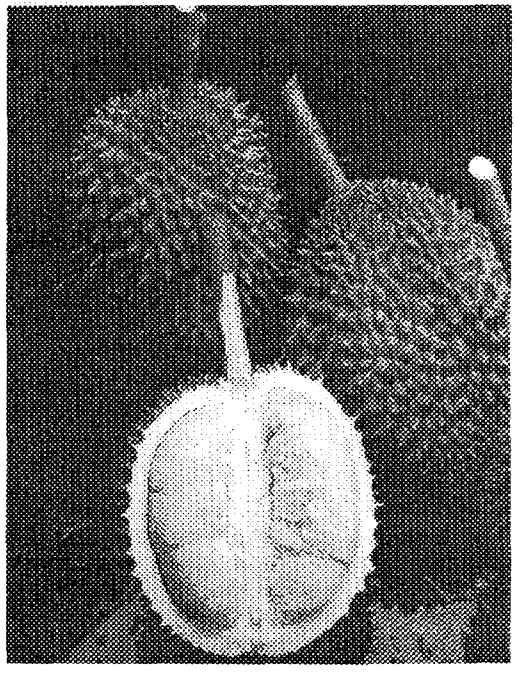

Figure 1. Typical characteristics of Durian

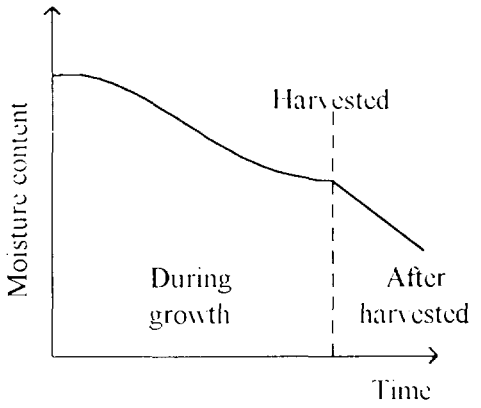

Figure 2 Predicted moisture content in Durian.

Experiment Procedure

Two nuclear techniques, Neutron Reflection and Neutron Transmission , were used in this research to study about the behavior of the moisture content in Durian by using Am-Be neutron source of 3 mCi, BF_3 thermal neutron detector and electronics modules. Firstly, The Neutron Transmission technique is the measurement of the neutron particle, called transmitted neutron, which transmit through the sample as shown in Figure 3.

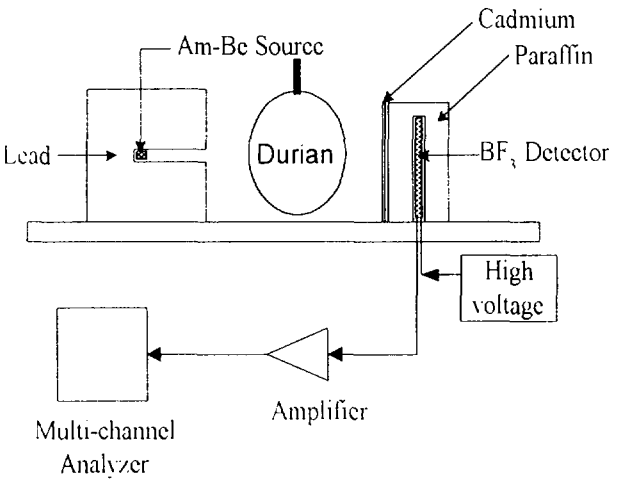

Figure 3 The arrangement of Neutron Tramsmission technique.

In order to have the neutron beam, the neutron source was placed in a 1.5 cm diameter and 15 cm deep lead collimator. The transmitted neutrons were measured by BF_3 detector, which was embedded in 10 cm thick of paraffin cylindrical block. To reduce the background from the source, sample and surrounding the paraffin block was shielded with a 0.1 cm thick cadmium sheet. The distance between the source and the detector was 30 cm and the measuring period was 30 minutes. By this technique, the variation moisture content of the Durian can be measured by the counting rate of the transmitted neutron. The increasing of counting rate means the decreasing of the moisture content.

Secondly, Neutron Reflection Technique, is the measurement of the neutron particle, called thermal neutron, which reflected from the sample. The source-sample-detector geometry is shown in Figure 4. The source and the detector were embedded in a cylindrical paraffin block of diameter 30 cm and of height 30 cm. In order to increase the signal-to-background response, the BF_3 detector was shielded by a 0.1 cm cadmium sheet except the side that close to the sample. The thermal neutrons were measured for 5 minutes. By this technique, the variation of the moisture content in Durian can be measured also by the counting rate. But in the opposite way with the first technique, the decreasing of counting rate means the decreasing of the moisture content.

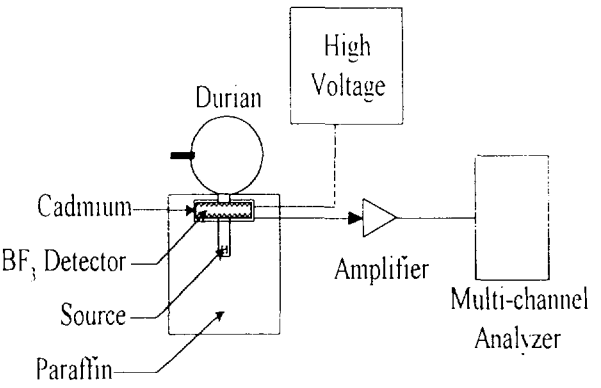

Figure 4 The arrangement of Neutron Reflection technique.

The results from the nuclear techniques were compared with a simple weighting technique. The decreasing of weight of Durian means the decreasing of the moisture content.

Results and Discussion

Three different sizes of Durian were utilized in the research. Figure 5 shows the relation between the weights with time of Durian after harvested. It can be founded that the weight of Durian linearly decreased with time at the first 5-7 days after harvested. The weight decreased about 10-15%, which depends on the temperature and humidity in the environment.

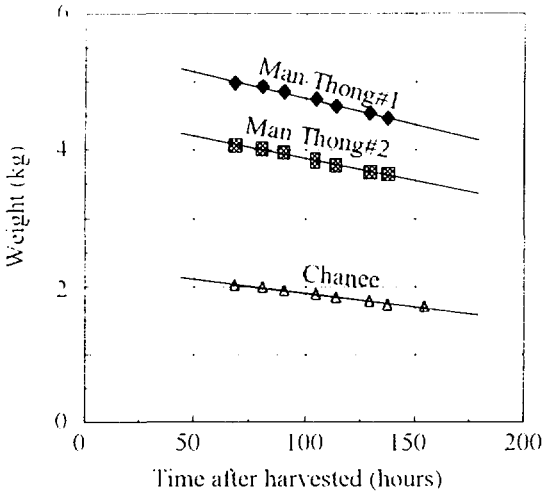

Figure 5 The relation between weight of Durian with time after harvested of three different sizes.

Figure 6 shows the relative count rate from the Neutron Transmission technique compared with the relative weight from the weighting method. The relative count rate linearly increased with time, which reversed with the weighting method. It implies that the counting rate of transmitted neutron increases when the moisture content in Durian decreases. These results are in conformity with the weighting method.

The results of the Neutron Reflection technique are shown in Figure 7. The relation between the relative count rate with time is linear but the slope of the relation is opposite with the results from the Neutron Transmission technique. The trend of the relative count rate-time corresponds to the weight-time relation but the slope is less than the weight-time relation. It implies that the thermal neutron decreases with the decreasing of the moisture content in Durian.

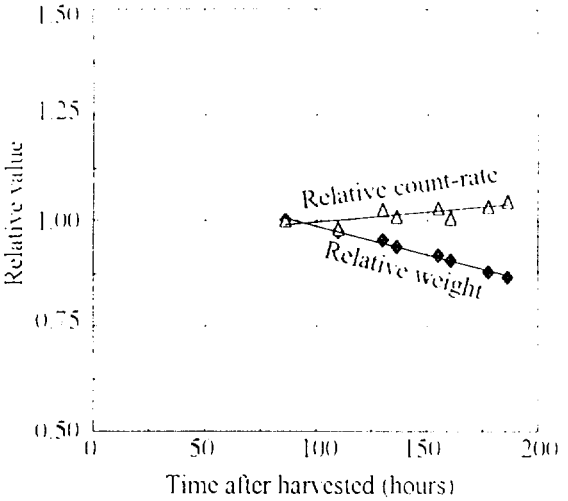

Figure 6 The relation between relative weight with time after harvested and relative count rate from the Neutron Transmission technique.

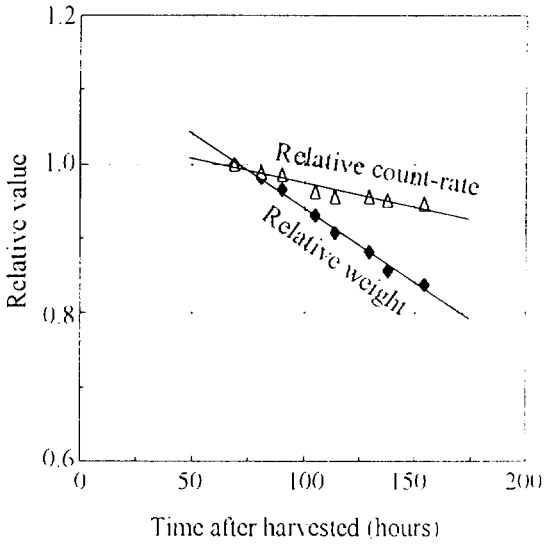

Figure 7 The relation between relative weight with time after harvested and relative count rate from the Neutron Reflection technique.

Conclusion and Recommendation

From the results of the counting rate by using Neutron Reflection and Neutron Transmission Techniques, it can be concluded that the behavior of the moisture content in Durian after harvested can be studied by these techniques. These techniques should be applied

and developed to study the moisture content during the growth period of Durian. The experiment system should be developed in order to have a high sensitivity and a short period of measurement.

Acknowledgments

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Next year Plans

1. Modification of the set-up shown in Figure 3 and 4 to increase the signal-to-background ratio and decrease the time for analysis.
2. Development of electronic parts for a complete counting system.
3. Measurement the water content in rice flour and potato flour.

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