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

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Abstract

Durian has been exported for several years. The quality of Durian is very important but the method to check its quality is still not reliable. An old traditional method to check the quality is counting days after its blossomming. The main factor that influences the quality of Durian is the moisture content which decreases with time during its growth and also after harvesting. The purpose of this research is to study the moisture content after harvesting by using the Neutron Reflection and Transmission techniques. From the test results, it was found that these techniques can be used to study the behavior of the moisture content in Durian, which corresponds with the weighing method.

Introduction

Durian is one of the exported fruits of Southeast Asian countries, such as Indonesia, Malaysia and Thailand. For Thailand, selling fresh Durian earns 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 are utilized by the farmer. In Thailand, the popular clones are Kop, Chanee, Kan Yao and Mon 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 the 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 decades the standard to check its quality has not yet been established. The traditional method is counting time method. A period of about 95-120 days after blossom, which depends on the clone and planting place, is needed before harvesting. After harvesting, the waiting period is about 7-14 days, which depends on the temperature and humidity of the environment, before it can be consumed. The other techniques are hearing different sounds when hitting it and smelling it. 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.

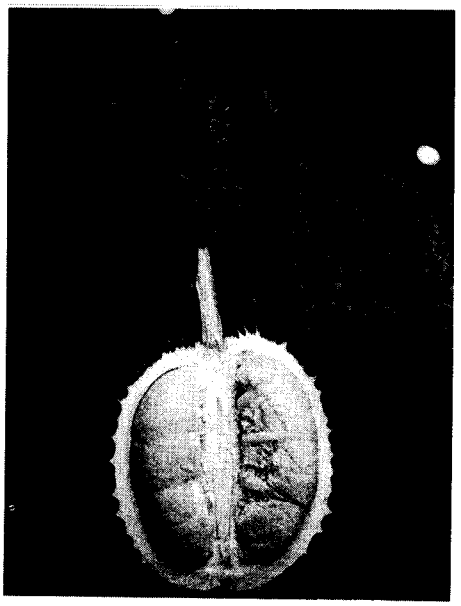

Figure 1. Typical characteristics of Durian.

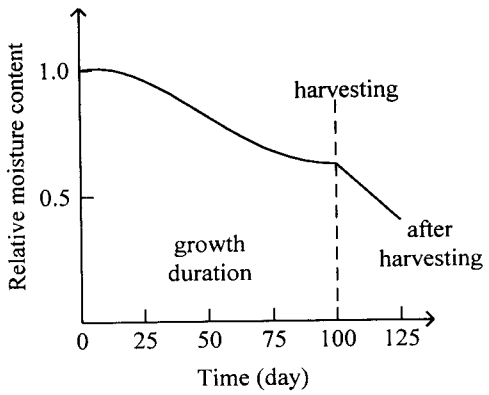

Figure 2 Predicted moisture content in Durian.

Experiment procedure

Two nuclear techniques, Neutron Reflection and Neutron Transmission , were used in this research to study 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 is transmitted through the sample as shown in Figure 3.

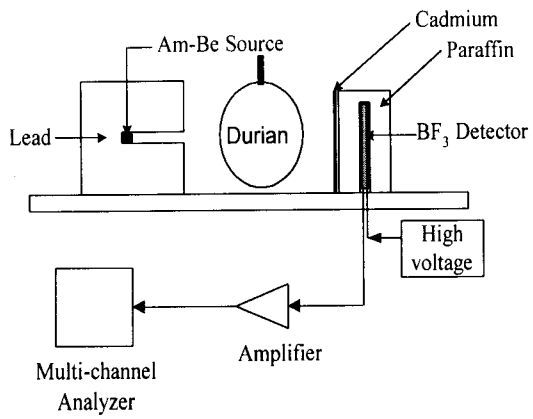

Figure 3 The arrangement of Neutron Tramsmission technique.

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 a 10 cm thick paraffin cylindrical block. To protect the background from the source, the sample and surrounding of 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 in moisture content of the Durian can be measured by counting the rate of the transmitted neutrons. An increase in the rate means a decrease in moisture content.

Secondly, the Neutron Reflection Technique is the measurement of the neutron particle, called thermal neutron, which is 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 was close to the sample. The thermal neutrons were measured for 5 minutes. By this technique, the variation of the moisture content in Durian can also be measured by the counting rate. But in the opposite way from the first technique, a decrease in counting rate means a decrease of the moisture content.

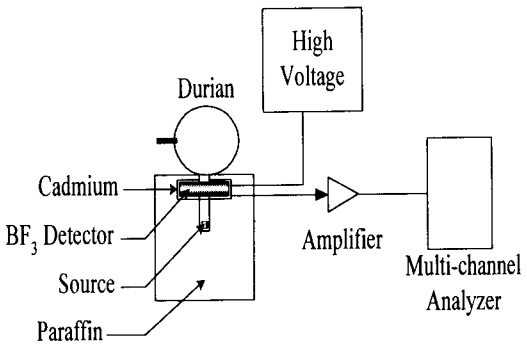

Figure 4 The arrangement of Neutron Reflection technique.

The results from the nuclear techniques were compared with the simple weighing technique. The decrease in weight of Durian means a decrease in the moisture content.

Results and discussion

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

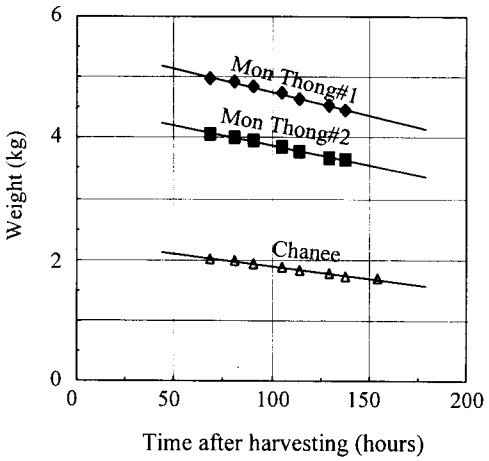

Figure 5 The relation between weight of Durian with time after harvesting, of three different sizes.

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

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

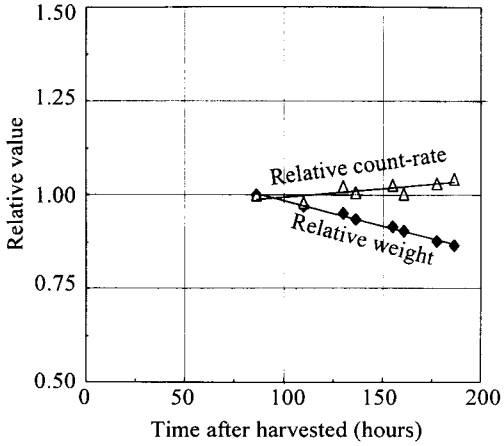

Figure 6 The relation between relative weight with time after harvest and relative count rate from the Neutron Transmission technique.

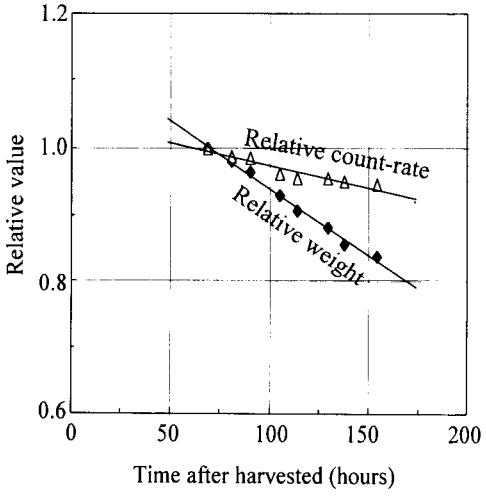

Figure 7 The relation between relative weight with time after harvest and relative count rate from the Neutron Reflection technique.

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 harvesting 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 experimental system should be developed in order to have high sensitivity and a short period of measurement.

Acknowledgements

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