THE EFFECT OF HOT WATER TREATMENT, DIFFERENT PACKAGING METHODS AND STORAGE TEMPERATURES ON SHELF LIFE OF DRAGON FRUIT
(*Hylocereus polyrhizus*)

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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged

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ABSTRACT

Dragon fruit (*Hylocereus polyrhizus*) are high valued crop and sold mainly for fresh consumption. Thus treatments are required to reduce the deterioration of physical appearance and damages due to disease attacks on fruits. These studies determined the effect of hot water treatment, different packaging methods and storage temperature on the shelf life of dragon fruit. The red-fleshed fruit used in the studies was at optimum ripeness and quality which is 5 to 6 days after fruit color change. At ambient, fruit stayed fresh for a few days after which its physical appearance deteriorated and disease infestation set in resulting in spoilage in 7 to 8 days. Fruits however remained fresh and disease-free for 8 days if stored at 10ºC with 90% relative humidity, but the fruits started to deteriorate and got spoiled after the 16th day. Fruit treated in hot water of 55ºC for 15 minutes and bagged in sealed polyethylene plastic bag without holes maintained their physical appearance better with much reduced disease infestation for up to 16 days in chilled storage as compared with those without heat treatment in similar storage conditions. The findings on extended shelf life of dragon fruit can be applied in local market to reduce wastage due to spoilage and to enable the marketing of this wonderful fruit to neighboring countries.

ABSTRAK

Buah naga (*Hylocereus polyrhizus*) merupakan tanaman yang mempunyai nilai yang tinggi dan biasanya dijual untuk dimakan segar. Oleh yang demikian, rawatan diperlukan untuk mengurangkan kerosakkan pada sifat fizikal buah dan jangkitan penyakit. Kajian ini dijalankan bertujuan untuk menentukan kesan rawatan air panas, cara pembungkusan yang berbeza dan suhu penyimpanan ke atas jangka hayat buah naga. Buah naga berisi merah yang mempunyai tempoh kematangan optimum iaitu 5 ke 6 hari selepas buah bertukar warna dan berkualiti tinggi digunakan dalam kajian ini. Dalam keadaan persekitaran, buah berkeadaan segar untuk beberapa hari dan selepas itu sifat fizikal luaran pada buah merosot dan jangkitan penyakit meningkat menyebabkan buah menjadi rosak dalam masa 7 ke 8 hari. Walaubagaimanapun, buah masih berkeadaan segar dan bebas daripada penyakit sehingga hari ke 8 sekiranya buah disimpan pada suhu 10ºC dengan 90% kelembapan udara. Namun, kualiti buah akan mula merosot dan rosak selepas hari ke 16. Buah yang dirawat dengan air panas pada suhu 55ºC selama 15 minit, kemudian disimpan dalam bag polietilena tanpa lubang dan disimpan sejuk mampu megekalkan sifat fizikal luaran buah dengan lebih baik disamping mengurangkan kadar jangkitan penyakit sehingga hari ke 16 berbanding dengan buah yang tidak dirawat pada suhu penyimpanan yang sama. Ini bertujuan untuk megekalkan tahap kualiti buah yang biasanya dimakan segar. Pereputan fungi pada buah merupakan salah satu faktor utama yang megehadkan tempoh penyimpanan buah. Fungi utama yang sering dikaitkan dengan kerosakkan pada buah adalah *Colletotrichum spp*, *Helminthosporium spp* dan *Fusarium spp*. Penemuan daripada kajian untuk meningkatkan jangka hayat buah naga boleh digunakan dalam pasaran tempatan bagi mengurangkan kerugian yang disebabkan oleh kerosakan. Ini membolehkan buah naga ini dieksport ke luar negara.

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LIST OF ABBREVIATIONS / SYMBOLS

ANOVA	-	Analysis of Variance
cm	-	centimeter
g	-	gram
H_2CO_3	-	carbonic
HWT	-	hot water treatment
MAP	-	modified atmosphere packaging
m	-	meter
ml	-	milliliter
mm	-	milimeter
mms^{-1}	-	millimeter per second
mt	-	metric ton
O_2	-	oxygen
PE	-	polyethylene
RH	-	relative humidity
°C	-	degrees Celsius
°F	-	degrees Fahrenheit
<	-	less than
>	-	more than
±	-	plus minus
%	-	percentage

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

The dragon fruit (*Hylocereus spp.*), which belongs to the cactus family is native to the tropical forest regions of Mexico and Central and South America; the vine-like epiphytic *Hylocereus* cacti are also cultivated in Vietnam, Taiwan, Southern China, Israel and more recently in Thailand, Australia, Philippines, United State and Malaysia (Wikipedia, 2008).

Dragon fruit or pitaya has been grown in Malaysia for at least 25 years, following their introduction by the French (Mizrahi et al., 1997). There are a number of species grown commercially namely; white-fleshed, *Hylocereus undatus*; and red-fleshed *H. costaricensis* and *H. polyrhizus* (Mizrahi et al., 1997). Locally, the fruit is known as 'Buah Naga' a description associated with the green colour of the immature fruit, and the 'dragon like' appearance of the 'scales' or bracts on the fruit surface. A member of the Cactaceae, the trailing cladodes; stems modified to act as leaves bear spectacular ovoid fruit year round which are a bright red colour when mature interspersed with small black seeds (Nerd et al., 1999).

Dragon fruit has an attractive colour and shape and is rich in dietary fiber, vitamin C as well as having large amount of minerals, notably phosphorus and calcium (Morton, 1987). It also has phytoalbumins which are highly valued for their antioxidant properties. It has less sugar content than most popular tropical fruits, and thus it is more suitable for diabetics and high blood pressure patients (Kueh et al., 2003). In Taiwan, diabetics use the fruit as a food substitute for rice (Felger et al., 1985). These attributes have led people to consider it as a healthy fruit and this is one of the reasons why it commands a premium price. The prevailing prices for locally produced red-flesh fruits in the domestic market are RM10-12 per kg respectively. With more plantings coming into production in near future, prices of this fruit are expected to come down to a more affordable level (To et al., 2002).

Locally, dragon fruits are sold mainly for fresh consumption. The deterioration of physical appearance and damages due to fruit flies (*Bactrocera spp*.) that are known to infest dragon fruit of commercial importance could render losses in value and spoilage (Drew et al., 2001). These losses are costly to retailers for such a high valued fruit. Recently, it has been established that dragon fruit are a host species for *B. dorsalis*, *B. correcta* and *B. cucurbitae* (Waddell et al., 1997). Consequently, some form of disinfestations treatment is likely to be required by the regulatory agencies of countries such as New Zealand, Australia, Japan and the US before dragon fruit will be accepted for importation (Joseph, 1997).

Although several studies have examined general postharvest aspects of dragon fruit (Wu and Chen, 1997, Nerd et al., 1999 and To et al., 2002), no widely available information currently exists as to the tolerance of dragon fruit to disinfesting hot

water treatments (HWT). Even in the absence of an approved HWT treatment for the quarantine actionable fruit fly species in Malaysia, there remains a need to quantify the impact of such treatments on fruit quality. Using fruit fly disinfestation protocols that bracket the range of approved treatments used internationally to disinfest commodities such as mango, papaya and eggplant (Armstrong, 1994 and Waddell et al., 1997), this work examines the effect of hot air treatments followed by different packaging methods and storage temperature on shelf life of dragon fruit (*Hylocereus polyrhizus*). Increasing its shelf life not only reduces spoilage locally but also augers well for fresh fruit export beyond the 'local' Asian markets of Singapore, Hong Kong, Taiwan and Philippines (Julia, 2006).

1.2 Problem Statement

There is growing demand for dragon fruit in nearby countries such as China, Hong Kong and Singapore. It also has good potential to be exported to European countries, as its taste is liked by Europeans (Julia, 2006). The exports of some dragon fruit from increased hectare of plantings result in the problem of supply glut which usually results in sharp downturn of prices in the local market. In the meanwhile, disease attack on fruit after keeping for a few days under ambient conditions could render losses in value and spoilage. These losses are costly to retailer for such a high valued fruit. Therefore, post harvest handling studies on the shelf life of dragon fruit has to be carried out not only to increase its shelf life but also to reduce the spoilage locally.

1.3 Significance of Study

Hot water treatment (HWT) which consists of submerging the dragon fruit in a hot water bath at a specific temperature for a specified time is an effective non-chemical method of post harvest pest and disease control. It is an alternative method to treat dragon fruit ensuring consumer satisfaction that are conscious about quality and health.

Furthermore, HWT that have been used to control fungal diseases and for insect disinfestations are currently one of the most easily applied, cheap and less hazardous method to extend the shelf life of dragon fruit compared to the use of chemical as well as showing no significant effect on the fruit quality. Therefore, immersion of dragon fruit in hot water could serve as an efficient method in increasing the shelf life and reduces the losses which are costly to retailers for such a high valued fruit.

1.4 Objectives of Study

1. To study the effect of hot water treatment in extending the shelf life of dragon fruit (*Hylocereus polyrhizus*).
2. To determine the effect of different packaging methods and storage temperature on the dragon fruit.