Drying Lychee Fruits (*Litchi chinensis* Sonn.) for Preserving Quality and Vitamin C

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Abstract

Fresh lychee fruits (*Litchi chinensis* Sonn.), even by cool storage, turn out to be storable only for a few days. To preserve quality, drying tests of lychee fruits were carried out and quality changes of the dried product were analysed in terms of colour, chemical and sensory parameters. Extended drying times caused by low drying air temperatures influenced quality matters. To improve quality of dried lychee fruits, pre-treatments before drying were tested and considered unnecessary.

Keywords: lychee, dried fruits, quality

1 Introduction

The lychee fruit is originated in South China. Due to its subtropical character it is often found in mountainous regions in Southeast-Asia, 600 m above sea level, with humid summers and cool, frost-free winters. The most important production areas today are China, Taiwan, India, Pakistan, Thailand, Vietnam, Indonesia, Madagascar, South Africa, Australia and even recently Israel and the United States (Kadam et al., 1995). Because of its sensitive character, the postharvest losses of lychee fruits are extremely high. The damage of fruits very often occurs just after harvest with the delicate storage and transport. Dried lychee fruits, known as lychee-nuts in China (Ross et al. 1969), recently gain increasing importance in Southeast Asia and South Africa. Due to their intensive exotic flavour, high vitamin C content and multifarious possibilities of uses, there might be potential markets in western industrialised countries as well.

2 Materials and Methods

2.1 Material

Fresh lychee fruits (cv. Mauritius), with an average weight of 18 g per stoned fruit, imported from South Africa were taken for the drying experiments in Hohenheim. Drying experiments at Chiang Mai University were carried out with fresh material (cv. Hong Huay) with an average weight of 16 g per stoned fruit, bought from the central market in Chiang Mai. Both varieties were untreated, stored for a few days in small vacuum-sealed bags at 2 - 4 °C if required, to ensure freshness and prevent pericarp browning. Only fruits with red coloured pericarp and equal unit weights were taken for the drying experiments. They were stoned with traditional Thai tools, named “toutou”. The pericarp was left with the fruits while drying, to get a better form and colour. To improve the quality of dried lychee fruits different pre-treatments were investigated at Chiang Mai University. Table 1 shows the presented pre-treatments.

Table 1: Pre-treatments, concentrations of solutions and treatment duration for lychee fruits, cv. Hong Huay

	control	SO_2	blanched	sucrose	citric acid
pre-treatment	XXX	Liquid sulphuring process (Häuser, 1995)	Dipping in fresh, boiled water	Dipping in sugar solution	Dipping in citric acid solution
concentration	XXX	5 %	90 °C	30 %	3 %
duration	XXX	10 min	5 min	10 min	10 min

2.2 Drying Methods

Drying experiments for the sensory evaluation and experiments with treated lychee fruits were conducted with a vacuum-cabinet dryer, constructed at the Department of Product Development Technology, Chiang Mai University. To determinate the drying behaviour and total vitamin C losses, a laboratory dryer developed at the Institute for Agricultural Engineering in the Tropics and Subtropics were used. These dryer allows to dry single layers of lychee fruits in an overflow mode under

standardised conditions due to an air flow control section, humidifier section and heating control section. The developed weighing device allows continuous weighing while drying. To prevent the effect of the air flow during weighing procedure, a bypass is automatically opened to discharge the drying air (Hofacker, 1986; Pass, 1996).

2.3 Analysing Methods

Water content

The water content of fresh and dried material was determined by the Karl-Fischer method, the homogenized sample will be suspended in diethanolamine/sulphur dioxide solution and titrated with a methanolic iodine-solution volumetrically.

Water Activity

The water activity or a_W value, characterising the reactivity or condition of water in foods, was determined by using a ROTRONIC AWVC meter. It is measuring directly the relative humidity above the sample while reading the electrical impedance of the air above the hygroscopic sample. A thermal compensation ensured the correction of thermal influences on the hygroscope substance and a small fan inside the measuring cell shortened up the measuring time.

Vitamin C Content

L-ascorbic acid (AA) and dehydro-L-ascorbic acid (DHAA) content were determined with HPLC techniques which is developed by Hutasingh (2000) for fresh and processed lychee fruits and expressed as total vitamin C content (total AA).

Fresh or dried lychee fruits were homogenized with m-phosphoric acid. An aliquot was taken for extraction with methanol, citric acid and ethylene diamine tetra acetic acid (EDTA). 20 µl of this solution were injected into the HPLC (LiChro CART® column 250-4, RP18). To determine DHAA, containing DHAA was reduced to AA by homocysteine and total AA was detected. Because both, AA and DHAA have similar

vitamin activity, total AA is to be calculated as the sum of AA and DHAA (Cooke, 1982).

Colour changes

Colour measurements in the CIE L*a*b* space (Hunter et al., 1969) were carried out by using a minolta chroma-meter CR-100. The results are presented as mean values of at least 12 successive measurements.

Sensory evaluation

To evaluate dried lychee fruits, nine Thai students and lectures, at Chiang Mai University, were chosen as panellist, who carried out the sensory evaluation with a five point structured scale to determine the characteristics of colour, aroma, texture/mouth feeling and taste. The presented characteristics are: colour and taste and the summarized results.

3 Results and discussion

3.1 Water activity

The a_W value of food products reflects their hygienic status. For safe storage of dried fruits without any growth of mould or yeast an a_W value of 0.6 is necessary. In Figure 1 the influence of water content and water activity is shown.

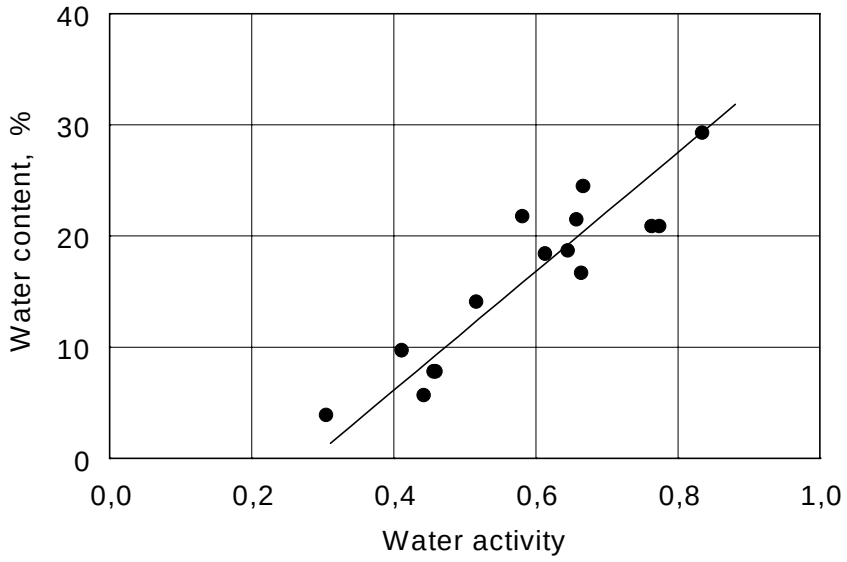

Figure 1 Influence of water content on water activity of dried lychee fruits

Lychee fruits, with a total soluble solid content of about 17 - 18 °Brix, should reach a water content of about 16 % to achieve a safe status. Rehydration because of high humidity or direct contact with water should be strictly avoided. With the hygroscope behaviour of dried fruits, the a_W value increases immediately.

3.2 Quality, influenced by drying temperature and drying time

Because drying times of different lychee fruits were influenced by their unit weights, the given drying experiments were carried out with lychee fruits of equal unit weights to gain comparable trials. Figure 2 shows the influence of the drying air temperature on the drying time of lychee fruits. The water content 16 % can hardly be achieved with drying air temperatures lower than 50 °C.

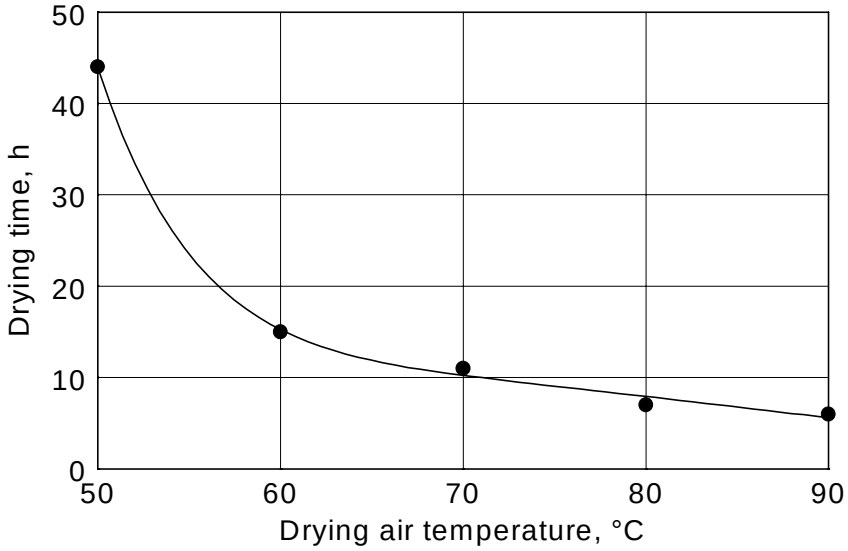

Figure 2: Influence of drying air temperature on drying time of lychee fruits (T_{dp}=25 °C, v_a=1.0 m/s)

The vitamin C content of the fruits not only depends on fruit varieties and maturity stages, but also on storage time and storage conditions (Agar et al., 1997). To evaluate the status of vitamin C of the fresh lychee fruits, the total AA content of three different stages of stored fruits were compared.

Pericarp browning occurs while storing fresh lychee fruits. It depends on storage time, storage temperature, loss of water in the pericarp and the

presence of oxygen while storage (Kadam and Deshpande, 1995, Nip, 1988). Here, pericarp colour was taken to characterize the three storage stages: “fresh” means no signs of pericarp browning were obvious, the colour is bright red; “still red” means the pericarp colour is just in the beginning to turn brown, but the aril was not affected; “brown” means the pericarp is completely brown and the aril already shows discolouring. Figure 3 shows the total vitamin C content of three different storage stages compared to fresh material and total solid.

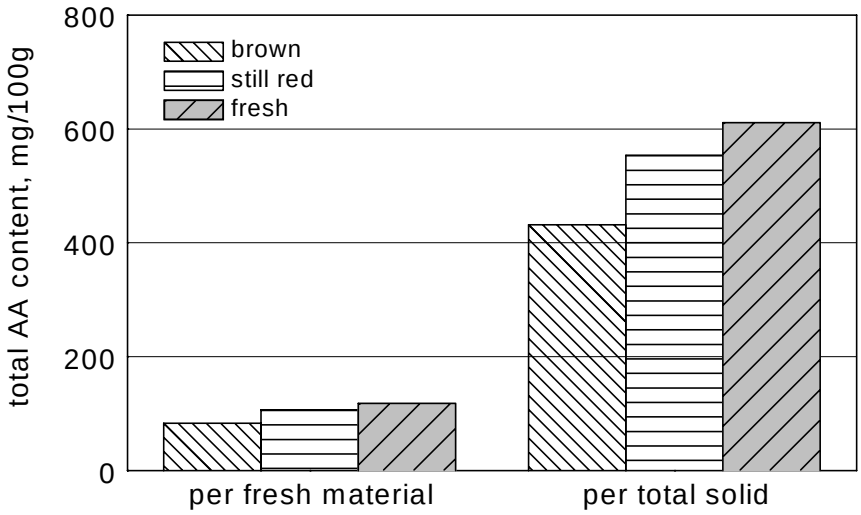

Figure 3: Effect of storage consequences on total vitamin C content of fresh lychee fruits

Total vitamin C losses due to storage made up to 30 % of original quantities. Total vitamin C contents as influenced by drying air temperature are shown in Figure 4. Drying lychee fruits reduced the vitamin C content to about 60 % of the original amounts.
Drying air temperatures or resulting drying times seem to produce no clear tendency for total AA losses especially in view of the significant influence of storage time and storage condition of fresh fruits. In contrast, DHAA increased with low drying air temperatures (40 or 50 °C), while AA decreased, but losses in total AA were low.

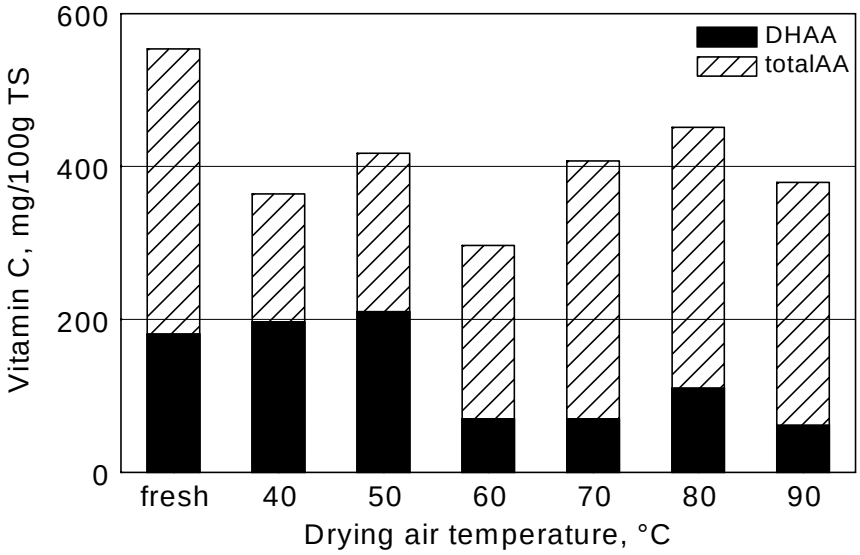

Figure 4: Effect drying air temperature on total vitamin C (total AA) and dehydroascorbic acid (DHAA) content of lychee fruits (T_{dp}=25 °C, v_a=1.0 m/s)

In terms of colour changes, the drying air temperature has an obvious effect on the appearance of dried lychee fruits. The experimental results are presented in Figure 5. Low drying air temperatures influenced the colour considerably. Slow drying rates and browning reactions while extended drying times indicate enzymatic reactions, probably by polyphenol oxidase, because of high a_W values and good thermal conditions (Vámos-Vigyázó, 1981).

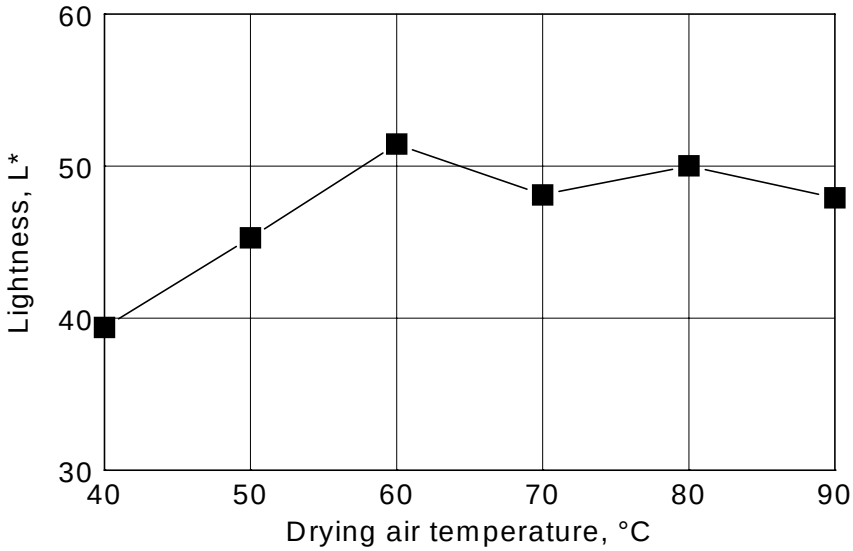

Figure 5: Influence of drying air temperature on colour changes of dried lychee fruits (T_{dp}=25 °C, v_a=1.0 m/s)

To preserve quality of dried lychee fruits, several pre-treatments were tested and sensually evaluated at Chiang Mai University. Figure 6 shows some results of the sensory evaluation.

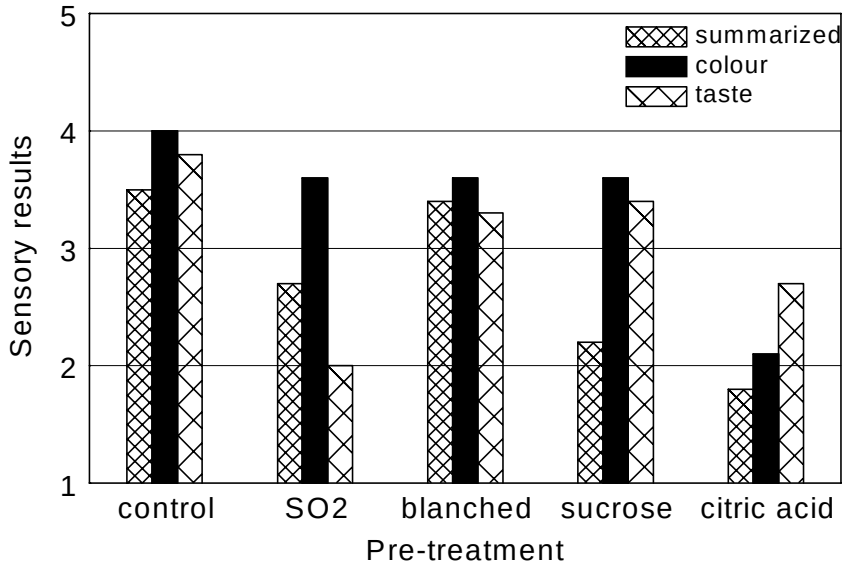

Figure 6: Sensory evaluation of dried, different treated lychee fruits (T=60 °C)

Summarized results were the sum of the sensory characteristics: colour, aroma, mouth feeling and taste. Here, the control was getting the best summarized result, followed by the blanched sample. Treating fresh lychee fruits to improve the quality of dried did not show an effect in colour or taste.

4 Conclusions

The study of drying lychee fruits to preserve quality shows a considerable influence of the drying time on browning reactions and DHAA changes. With low drying air temperatures, the required water content of 16 % can hardly be achieved. Resulting extended drying times influenced colour changes significantly. To preserve the high vitamin C content of lychee fruits, drying of really fresh fruits, without any signs of pericarp browning, is necessary. The total vitamin C content is decreased within the drying process. The drying air temperature has no

significant influence on the different total vitamin C losses, while DHAA contents increased at the AA content expense. Final total vitamin C losses of 33 % were reached. Tested pre-treatments were refused by sensory tests.

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