NU Science Journal 2009; 6(S1): 114 - 122

The Color Attribute Improvement of Dried Longans

Unnop Tassanaudom[1]* and Nanthaya Kengkhetkit [2]

[1] Rajamangala University of Technology Lanna Phitsanulok Campus /Department of Agro-Industry, Faculty of Science and Agicultural Technology, Phitsanulok, Thailand

[2] Rajamangala University of Technology Lanna Phitsanulok Campus /Department of Science, Faculty of Science and Agicultural Technology, Phitsanulok, Thailand

*Corresponding author.E-mail: unnop_tas@hotmail.com, Tel: +66-55-298438 ext 121

ABSTRACT

The objective of this research was to study the effect of chemical reagents on color attribute of dried longans. The experimental design used was completely randomized design with 3 replications. Longans were pretreated by 5 different chemical solution which were 1) 0.02%w/v potassium metabisulfite (KMS); 2) 0.5%w/v ascorbic acid; 3) 0.5%w/v citric acid; 4) mixed solution of 0.02%w/v KMS, 0.5%w/v ascorbic acid and 0.5%w/v citric acid and 5) water (control). After soaking for 10 minutes, the samples were dried in tray dryer at 60 ^{o}C for 15 hrs. L, a, b value, moisture content, ash content, pH, total soluble solid (TSS), total sulfurdioxide content, total viable count and yeast and mold of the samples were determined. The sensory evaluation of dried longan products were evaluated by 50 untrained panelists. The result showed that using sulfite solution (only type or more of chemical reagent) to soak fresh longan for 10 mins before drying could improve the color attribute of dried long products because the products had more lightness and golden-yellow appearance. At the same time, they could reduce a value (red color) that occured from browning reaction better than using only citric and ascorbic solutions. Five conditions used in the research were non-significantly different from moisture content and TSS ($P>0.05$). However, ash, pH and total sulfurdioxide of products were significantly different ($P\leq0.05$). The residual quantity of sulfurdioxide in finished products did not standard limit. In addition, sulfite solution could be inhibit morn microbial growth than water and other acid solutions. Finally, the research found that the color attribute was a more important factor on a preference score than other attribute.

Keywords: dried longans, color attribute, improvement

INTRODUCTION

Longans *(Dimocarpus longan* Lour.) are a type of commercial fruit of Thailand. They are very famous for their deliciously sweet and thick flesh and are consumed not only in domestic but also in foreign countries. About 5 years ago (2003-2007), longan production in the market has increased continuously. Therefore, the price has been dramatically decreased (Kulwattanaporn, 2004). Dried longan processing was used to solve this problem. The optimum process of high quality (18% moisture content) was used for 12 hrs. at 55 ^{o}C. Important factors in the production of dried longans were the cultivar of longan, the processing such as drying time, hot air temperature, air velocity and drying capacity of browning reaction control with both enzymatic and non-enzymatic browning (Pumkert *et al*., 1996). Brown to Dark brown flesh was the main problem of dried longan product. An increasing in brown color from enzymatic browning reaction might occur because of damaged longan from unappropriate harvesting. Sometime the process of raw material preparation such as cutting, peeling and trimming, may induce the excretion of polyphenol oxidase (PPO) from plant tissue. PPO was well mixed with a precursor of browning reaction with oxygen as catalysts (Whitaker, 1995). On the other hand, defect could occur from non-enzymatic browning such as the reaction of amino group and sugar in plant cell (Maillard reaction) and caramailization. This effect bring about dark brown color after the production process or during storage and sensory quality was degraded and changed. (M.deMan., 1990). Using optimum condition of drying, combined with some food additive (organics acid and sulfite compound), could prevent browning reaction. Especially, citric acid and potassium metabisulfite were used to reduce browning reaction in many types of fruit (Taylor and Bush. 1986). However, nobody used them and combined with the optimum condition in dried longan production. Thus, the objective of this research was to study the effect of chemical reagents on color attribute of dried longan for lightness and golden-yellow appearance.

METHODOLOGY

Longan fruit cultivar Edor with size AA,Φ 2.5 cm was obtained from Jitpaisan Garden, Phitsanulok. Before using in the experiment, the fruit stored in freezing room at 4 ^{o}C

The Production of Dried Longans

The experimental design used was completely randomized design with 3 replications. The longans were pretreated by 5 different chemical solutions which were 1) 0.02% w/v potassium metabisulfite (KMS); 2) 0.5% w/v ascorbic acid; 3) 0.5% w/v citric acid; 4) mixed solution of 0.02% w/v KMS, 0.5%w/v ascorbic acid and 0.5%w/v citric acid and; 5) water (control) before drying in tray dryer. The process of dried longans production was as shown in Figure 1.

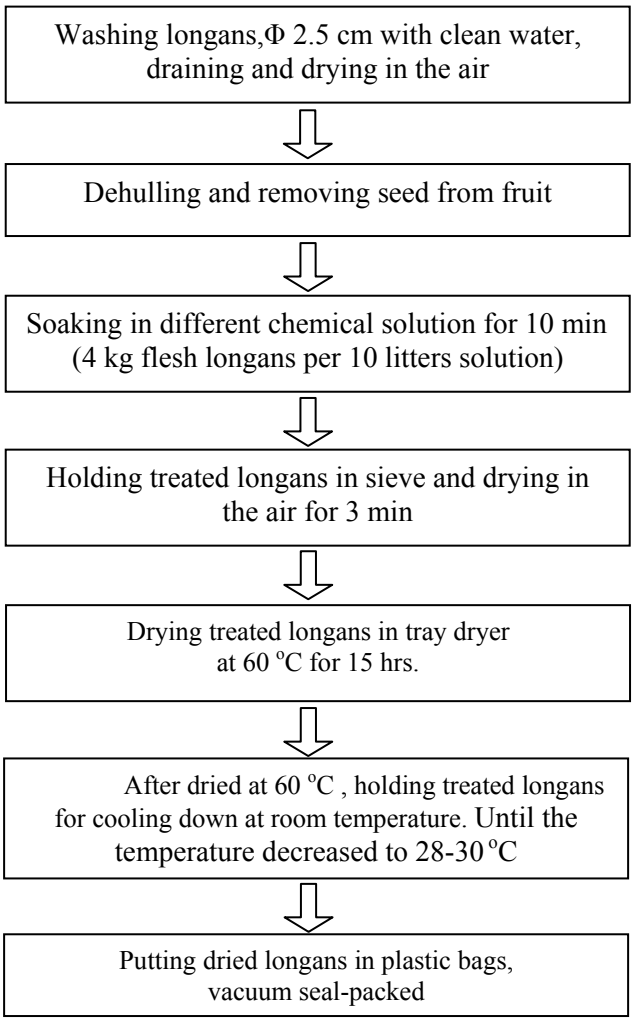

Figure 1 The process of dried longans production

Physical, Chemical and Microbial Characteristics of Dried Longans

Color change of the samples was examined by using HUNTER LAB (Colorflex® : Hunter Lab Colorflex 4510, Hunter Association Laboratory,Inc. America) in L a b unit where L represents the lightness, a (+) represents the redness, a (-) represents the greenness, b (+) represents the yellowness and b (-) represents the blueness . Moisture content and Ash content were determined by AOAC method (AOAC,2000). Acidity was determined by pH meter (HACH : EC 30, Scientific Promotion Ltd., Germany). Total soluble solid (TSS) was measured by using hand refractometer (N.O.W. Tokyo, Japan). Total residual sulfurdioxide content was determined by AOAC method (AOAC, 2000). Total viable count and yeast and mold of the samples were determined by APHA. (Downes and Ito, 2001)

Sensory Evaluation of Dried Longans

The experimental design used was Randomized Complete Block Design (RCBD).Sensory Evaluation of dried longans was tested on appearance (size and shape), color, flavor, texture and overall preference with 9-point hedonic rating scale by 50 untrained panelists. (Anprung, 2004)

Statistical Analysis

The statistical analysis was carried out with ANOVA. The least significant difference (LSD) procedure was used to test differences between mean. The results were considered significant at $p \leq 0.05$.

RESULTS AND DISCUSSION

1. Production of Dried Longans

The color of dried longans pre-treated with 5 different chemical solutions were shown in Figure 2. It was found that the lightness of dried longans was different. The lightness of sample T_1 was similar to sample T_2 and T_3, and was to decreased in Sample T_4 and T_3, respectively. The result from Figure 2 shows that dried longans pre-treated with different solution have the same appearance (size and shape),but the samples odor has a specific aroma. All samples were not found off-flavored.

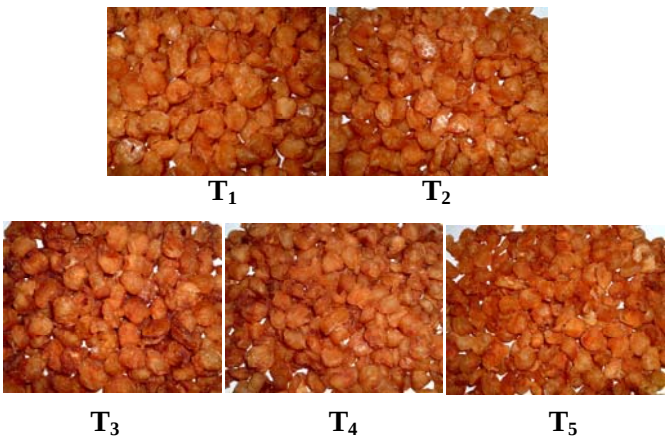

Figure 2 Dried longans pre-treated with 5 different chemical solutions
T_1 = washed with clean water (control),
T_2 = treated with 0.02%w/v KMS,
T_3 = treated with 0.5%w/v ascorbic acid,
T_4 = treated with 0.5%w/v citric acid,
T_5 = treated with 0.02%w/v KMS, 0.5%w/v ascorbic acid and 0.5%w/v citric acid

2.Physical, Chemical and Microbial Characteristics of Dried Longans

2.1 Effect of pre-treated solution on color of dried longans

The color value (L a b unit) of dried longans were pre-treated with 5 different chemical solutions was as shown in Table 1.

Table 1 L a b value of dried longans pre-treated with 5 different solutions

Sample	Color Value		
	L	a	b
T_1	42.5^{b} ±0.1	9.8^{b} ±0.3	19.0^{b} ±0.2
T_2	42.8^{a} ±0.1	10.4^{b} ±0.8	19.4^{a} ±0.1
T_3	34.5^{d} ±0.1	12.3^{a} ±0.4	16.3^{d} ±0.2
T_4	37.9^{c} ±0.1	10.2^{b} ±0.3	17.5^{c} ±0.2
T_5	42.7^{ab} ±0.1	10.3^{b} ±0.1	19.3^{ab} ±0.2

* Mean within the same column with different letter are significantly different ($p \leq 0.05$)

From this research, the longans pre-treated with 5 different solutions were dried at low temperature (60 ^{o}C) that not affect to occurring caramelization. In this experiment, browning reaction of dried longans was affected by Enzymatic browning.

Table 1 shows similar results of longans treated with 0.02% w/v KMS (T_2), 0.02% w/v KMS, 0.5% w/v ascorbic acid, 0.5% w/v citric acid (T_5) and the control (T_1). The highest lightness, glogen-yellow color and no brown discoloration were observed. Therefore, longans pre-treated with KMS in T_2 and T_5 could inhibit browning compound, and was found to be very effective in the inhibition of both enzymatic and non-enzymatic browning. Because the experiments of dried longans pre-treated with 5 different chemical solution were done in a dryer, gaseous sulfur dioxide was circulated around tray dryer, Thus the golden-yellow color and no brown discoloration of dried longans was observed for sample T_1 too. In application, using citric acid in pre-treatment of dried longans (T_4) resulted in golden-yellow color more than pre-treated with 0.5% w/v ascorbic acid (T_3). However, their L values were lower than T_2,T_5 and T_1, respectively.

The sample that was pre-treated with 0.5% w/v ascorbic acid (T_3) had increase browning due to oxidation reaction of ascorbic acid by light and oxygen , which produced the red-to-brown color.

It can be concluded that using sulfite solution (only type or mixed with other chemical reagent) to soak the fresh longan for 10 minutes before drying could improve the color attribute of dried longans product because the product had more lightness and golden-yellow appearance.

2.2 Effect of pre-treated solution on chemical properties of dried longans

The moisture content, percentage of ash, pH, total soluble solid (TSS) and total residual sulfur of dried longans pre-treated with 5 different chemical solutions were presented in Table 2.

Table 2 Chemical properties of dried longans pre-treated with 5 different solutions

Sample	Moisture (%)	Ash (%)	pH	TSS (^{o}Brix)	Residual sulfur (ppm)
T_1	$15.3^{ns} \pm 0.2$	$0.4^{d} \pm 0.1$	$6.4^{a} \pm 0.2$	$72^{ns} \pm 1$	$693^{c} \pm 5$
T_2	$15.2^{ns} \pm 0.3$	$4.2^{ab} \pm 0.6$	$6.4^{a} \pm 0.2$	$71^{ns} \pm 1$	$1497^{b} \pm 5$
T_3	$15.6^{ns} \pm 0.4$	$3.2^{c} \pm 0.6$	$6.1^{a} \pm 0.2$	$70^{ns} \pm 2$	$690^{c} \pm 4$
T_4	$15.0^{ns} \pm 0.2$	$3.8^{bc} \pm 0.2$	$5.7^{b} \pm 0.2$	$70^{ns} \pm 1$	$681^{c} \pm 8$
T_5	$15.0^{ns} \pm 0.4$	$4.6^{a} \pm 0.4$	$5.1^{c} \pm 0.2$	$71^{ns} \pm 1$	$2324^{a} \pm 8$

* Mean within the same column with different letter are significantly different ($p \leq 0.05$)
^{ns} are not significantly different at $p > 0.05$

The percentage of ash, pH and total residual sulfur of dried longans pre-treated with 5 different chemical solutions were significantly different, as shown in Table 2. However, the moisture content (MC) and total soluble solid (TSS) were not significantly different. MC, ash and pH of dried longans in all sample were approximately 15%, 0.4-4.6% and 5.1-6.4, respectively, which did not exceed the limitation of Standard for hygienic practice for dried fruits (Ministry of Industry Thailand, 1989) The TSS of dried longans, presenting in their sweetness was in the range of 70-72 ^{o}Brix. When compared the residual sulfur of dried longans pre-treated with 5 different chemical solutions with the limitation of Food and drug administration Thailand (Notification of the Ministry of Public Health NO.84, 1984), it did not exceed the standard limits (not more than 2,500 ppm) as well. While the research report of Chutichudet and Chutichudet (1998) found that dried longans pre-treated with 1% sodium metabisulfite had a golden-yellow color but their residual sulfur was over the standard limits of FDA Thailand. However, they found that a residual sulfur was reduced during storage and they recommended consumers to consume dried longans after 3-month storage.

2.3 Effect of pre-treated solution on microbial properties of dried longans

The total count and yeast and mold count of dried longans, presenting in their cleanness and safeness were determined in the range of 2.72-4.96 and 2.06-3.12 log cfu/g, respectively. These were presented in Table 3.

Table 3 Amount of microorganism in dried longans pre-treated with 5 different solution

Sample	Microbial Type (log cfu/g)	
	Total count	**Yeast and Mold count**
T_1	4.96^{a} ±0.19	3.12^{ns} ±0.27
T_2	2.81^{c} ±0.14	2.06^{ns} ±0.59
T_3	3.49^{b} ±0.20	2.93^{ns} ±0.59
T_4	3.43^{b} ±0.49	2.86^{ns} ±0.48
T_5	2.72^{c} ±0.24	2.32^{ns} ±0.24

* Mean within the same column with different letter are significantly different ($p \leq 0.05$)
^{ns} are not significantly different at $p > 0.05$

Table 3 shows the amount of total count (aerobic plate count by pour plating technique) of dried longans from longans pre-treated with 5 different chemical solutions was significantly different, but yeast and mold count was not significantly different. However, this research found that using sulfite solution to soak flesh longan before drying could inhibite microbial growth more than water and other acid solutions. It could decrease amount of microbial for 1-2 log cfu/g (90-99%). The Standard for hygienic practice for dried fruits limits the amount of total count and yeast and mold to not more than 4 and 2 log cfu/g, respectively (Ministry of Industry Thailand, 1989). From the results, Sample 1 (soaked with water), has the amount of total count and yeast and mold that exceeds the limitation. In addition, decreasing of Microorganism in the sample could extend shelf-life of the product.

3. Sensory Evaluation of Dried Longans

Results from 50 untrained panelists showed the attribute of size and shape, color, flavor, texture and overall preference scores were like slightly to like moderately in the score range of 6.0-6.7, 5.9-7.1,6.5-7.2, 6.3-7.0 and 6.5-7.3, respectively, and were significantly different ($p \leq 0.05$) as shown in table 4.

Table 4 Sensory evaluation result of dried longans pre-treated with 5 different solution

sample	Size/shape	Color	Flavor	Texture	Overall preference
T1	$6.7^{a} \pm 1.5$	$7.1^{a} \pm 1.3$	$7.2^{a} \pm 1.0$	$7.0^{a} \pm 1.3$	$7.3^{a} \pm 1.1$
T2	$6.5^{ab} \pm 1.4$	$7.1^{a} \pm 1.1$	$6.6^{b} \pm 1.2$	$6.6^{a} \pm 1.4$	$6.9^{ab} \pm 1.0$
T3	$6.0^{bc} \pm 1.5$	$5.9^{c} \pm 1.4$	$6.5^{b} \pm 1.5$	$6.3^{bc} \pm 1.9$	$6.5^{bc} \pm 1.3$
T4	$5.6^{c} \pm 1.8$	$6.2^{bc} \pm 1.4$	$6.4^{b} \pm 1.5$	$6.0^{c} \pm 1.4$	$6.3^{c} \pm 1.4$
T5	$6.3^{ab} \pm 1.6$	$6.6^{ab} \pm 1.4$	$6.6^{b} \pm 1.2$	$6.5^{b} \pm 1.5$	$6.8^{b} \pm 1.3$

* Mean within the same column with different letter are significantly different ($p \leq 0.05$)

This research found that the score value in each attribute of all samples were significantly different. However, the score value 6.0-7.0 was expressed as like slightly. However, this result of sensory evaluation was conflicted with physical result (L a and b value) because the color perception of panelists were not different.

CONCLUSION

Using 0.02% potassium metabisulfite (KMS) solution and combination of KMS with other chemical reagents to soak flesh longan (without stone) before drying process for 10 minutes could improve color quality attribute of dried longans to lightness and golden-yellow appearance, when compared with the control (soaked with water), 0.05% ascorbic acid and 0.5% citric acid solution. The residual quantity of sulfurdioxide in finished products did not exceed standard limit. In addition, sulfite solution could inhibit microbial growth more than water and other acid solutions. This research also found that the color attribute was a more important factor on a preference score than other attribute rate by panelists.

ACKNOWLEDGMENTS

The authors would like to thank Rajamangala University of Technology Lanna Phitsanulok Campus for financial support.

REFERENCES

Anprung, P. (2004). The Principle of Sensory Simulation for Food Analysis. 1st. Chulalongkorn University. Thailand.

AOAC. (2000). Association of official Analytical Chemists. Official method of Analysis. 17th ed. AOAC international. Galthersbury, Maryand. 2087-2417. USA.

Chutichudet, B. and Chutichudet, P. (1998). Development for drying longans. Research report. Department of Agriculture Technology, Faculty of Technology Mahasarakham University, Thailand.

Downes, F.P. and Ito, K. (2001). ComPendium of Methods for the Microbiological Examination of Food. 4ed. American Public Health Association. Washington DC.

Kulwattanaporn, S. (2004). People Technology News. Thailand Institute of Scientific and Technoogical Research.

M.deMan, J. (1990). *Principles of Food Chemistry*. 2nd edition. AVI Book, New York, USA.

Ministry of Industry Thailand. (1989). Industrial Standard of Dehydrated Fruits. Bangkok, Thailand.

Notification of the Ministry of Public Health NO.84. (1984). Re:Food Additive. Food and drug administration Thailand. Bangkok, Thailand.

Pumgert,W., Chutichudet, B. and Chutichudet, P. (1996). Studied on appropriate conditions for drying Euphoria longana Lank. *Journal of Sciences Khon Kaen University*, *24*(4), 252-260

Taylor, S.L. and Bush, R.K. (1986). Sulfites as food ingredients. *Journal of Food Technology, 40*(60), 47-52

Whitaker, J.R. (1995). Polyphenol oxidase. 271-307. *In Food Enzymes, Structure and Mechanism*. Ed. By Wong, D.W.S. Chapman & Hall. Inc. New York, USA.