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EFFECT OF BANANA VAIETY AND PUFFING CONDITIONS ON PUFFED BANANA QUALITY

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ABSTRACT

The high temperature and short time (HTST) was applied to a various banana variety for crisp banana producing. The HTST puffing suitable for producing of crisp banana because HTST can create high porous structure and more crisp texture as compared with hot air dried product. However, no previous literatures study the effect of banana variety of puffed product quality.The objective of this experiment was to study the effect of banana variety (Numwa-banana and Homtong-banana) and puffing condition (puffing temperature and puffing time) on puffed banana qualities i.e. colour, volume ratio and texture property. The banana slices with 16-23°Brix total soluble solids were blanching in hot water for 30 sec. After that, it were dried in 3 steps. First step, it was dried by hot air at temperature of 90°C until the banana moisture content reached 35% dry basis. Then, the banana were puffed by hot air (130-170°C) for a short duration (1.5-2.5 min) in a laboratory HTST model. Final step, it was dried again by hot air at temperature of 90°C to moisture content of 4% dry basis. The experimental results showed that the banana variety affected on product quality. The puffed Numwa-banana had harder texture than puffed Homtongbanana. In addition, the Namwa-banana had better colour quality than those Homtong-banana, it indicated by lower ΔE. The puffing conditions, puffing temperature and puffing time, strongly affected on colour, volume ratio and textural properties of banana product. Increasing of puffing temperature together with longer puffing time provided higher volume ratio and more crisp texture. However, the color of product in both of banana varieties had more browning as higher puffing temperature and longer puffing time.

Keywords: Crisp banana; Puffing; Banana variety; Colour; Texture

INTRODUCTION

Banana is the most consumed fruit and it had many varieties in Thailand and other tropical countries. The banana deteriorates rapidly after harvesting. To reduce its losses, the banana is processed to various types of banana product, i.e. fried banana, dried banana and banana puree. The dried banana is one of an alternative way to preserve its quality and add its value. The alternative drying methods such as and high temperature and short time drying [1,2], microwave drying [3], lowpressure superheated steam drying [4,5] were used to produce crisp dried banana.

The higher temperature and short time drying or puffing technique is an attractive method to produce high crisp banana because it is more economical than those other methods. Hofsetz et al. [6] found that the banana that processed by puffing technique combined with hot air drying had higher volume than that drying by hot air at 70°C only. This is due to high vapour pressure force food structure to expand during puffing process. The higher volume of puffed banana product induced more crisp texture than that the hot air dried product. In addition, the puffing condition affects on puffed product quality. Higher puffing temperature and longer puffing time promoted higher puffed volume and more crisp texture [7, 8], However, it had a few literature reported the effect of fruit variety on quality of crisp product. Lefort et al. [9] reported that the variety of potato influence on texture of potato chip. The chip had more crisp texture as it had

Therefore, the objective of this study was studied the effect of puffing temperature,

puffing time and banana variety on banana qualities such as texture, volume ratio and colour. lower specific gravity and starch content.

MATERIALS AND METHODS

Material preparation

Fresh banana were bought from Tungkru market and its soluble solid contents was in the range of 21-23°Brix for Numwa-banana and 16-18°Brix for Homtong-banana. Before processing, the banana was cross sectional cut into 2.5 mm thickness and blanched by hot water at 95°C for 30 sec.

Puffing process

Puffing process in this study consisted of three main steps; pre drying, puffing and post drying. In pre drying step, the banana slices were dried by hot air at temperature of 90°C under air velocity of 2 m/s. After the moisture content of banana samples reached to 35% dry basis (d.b.), the samples were puffed by hot air at temperatures of 130, 150 and 170°C for 1.5, 2 and 2.5 min. In post drying step, the samples were dried with hot air at the same temperature as pre drying step. The final moisture content of product required at 4% d.b.

Volume ratio determination

The fifteen banana samples were used to determine volumetric ratio. The volume of banana sample was determined by the solid displacement method using glass breads [10]. The banana volume was calculated using following equation:

$$V = \frac{M_b - [M_{s+b} - M_v - M_s]}{\rho_b} \quad \ldots(1)$$

where M_b is the mass of vessel filled with glass breads, M_v is mass of empty vessel, M_{s+b} is mass of vessel plus glass breads and banana sample, M_s is the mass of sample and ρ_b is the density of glass breads.

The %volumetric ratio was defined as the ratio of the dried banana volume to the original banana volume

$$\%\ \text{volumetric ratio} = \frac{V}{V_i} \times 100 \quad \ldots(2)$$

where V_i and V are the volume of the fresh sample and the volume of dried sample, respectively.

Colour evaluation

The fifteen banana samples were used to evaluate colour. The colour of dried samples were measured using a colorimeter (ColourFlex, HunterLab, Buckinghamshire, UK). For each banana sample, the measurement was performed at banana surface at six different positions and the average value was reported. The colour was expressed as Lvalue (Brightness), a-value (redness/greenness) and b-value (yellow-ness/blueness). The overall colour of banana product presented in term hue angle (^{0}h), which was calculated from $^0h = \tan^{-1}(b/a)$. The total colour change (ΔE) was calculated from Eq. (3)

$$\Delta E = \sqrt{(L - L_0)^2 + (a - a_0)^2 + (b - b_0)^2} \quad \ldots(3)$$

Texture evaluation

The banana texture was measured by using the texture analyzer (Stable Micro System, TA. XT. Plus, Haslemere, UK) with a 5 N load cell. The banana samples were fractured with a cutting probe (HDP-BSK type). The maximum compressive force, the initial slope and the number of peaks (over 50 g force threshold) from force deformation curve were considered as hardness and crispness, respectively.

Statistical analysis

The data of puffed product quality, i.e. colour, volume ratio and texture, was analyze using analysis of variance (ANOVA), which indicate the effect of operating condition on product quality. Turkey's test was used to establish the multiple comparisons of the mean values. The mean values were considered significantly different when $p \leq 0.05$.

RESULTS AND DISCUSSION

Effect of puffing temperature and puffing time on volume ratio and texture.

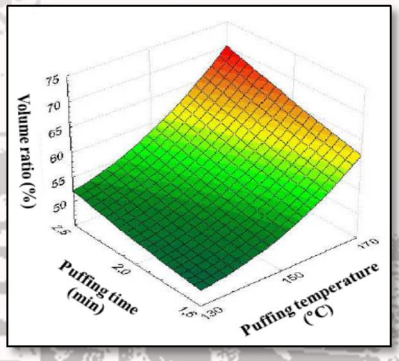

Fig 1. Effect of puffing temperature and puffing time on %volume ratio of Numwa-banana.

Fig 1. shows the effect on puffing temperature and puffing time on volume ratio of Numwa-banana. The 8th TSAE International Conference (TSAE2015) March 17-19, 2015; Bangkok, Thailand

banana volume ratio tends to increase as higher puffing temperature and longer puffing time. The highest volume ratio was observed at 170°C-puffing temperature and 2.5 min-puffing time. This is because remained moisture available in sample rapidly evaporates which allows for building vapour pressure in sample [7,11,12]. However, the puffing temperature stronger effect on volume expansion than those puffing time. The banana texture was presented in term of hardness and the number of peaks, it was presented in Fig. 2 and 3, respectively. Increasing puffing temperature level together with longer puffing time promoted more crisp texture, it indicated by lower hardness and higher the number of peaks. This is due to larger puffed volume was created under higher level of puffing temperature and puffing time condition. Therefore, the larger cavities were generated inside puffed structure, resulting in the solid matrixes become weaker at large puffed volume [2,6].

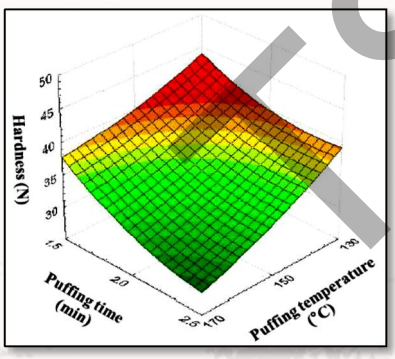

Fig 2. Effect of puffing temperature and puffing time on hardness of Numwa-banana.

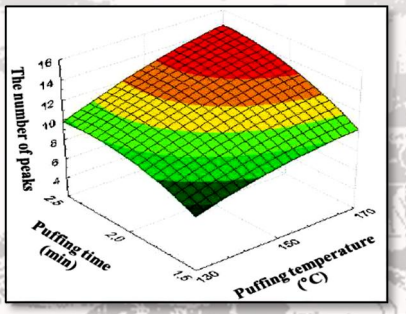

Fig 3. Effect of puffing temperature and puffing time on the number of peaks of Numwa-banana.

Effect of puffing temperature and puffing time on colour.

Fig. 4 shows the effect of puffing temperature and puffing time on L-value and hue angle of Numwa-banana. Increasing puffing temperature level together with longer puffing time induced brown colour on puffed banana, it was indicated by lower value of L and hue angle. This could be explained by the fact that the higher puffing temperature and longer puffing time accelerated nonenzymatic browning reaction development [10, 13]. In adition, the Numwa-banana was puffed beyond 150^0C of puffing temperature had more scorching at the edge of its sample, it presented in Fig. 5(c).

Effect of banana variety on puffed product quality.

The puffed banana quality were compared between Numwa-banana and Homtong-banana, as presented in Fig. 6. The Numwa-banana had lower degree of puffed volume than those the Homtong-banana in all puffing temperature level, as presented in Fig. 6(a). This may be due to the high density of internal structure of Numwab-anana retards the volume expansion. Therefore, Numwaba-nana had harder texture than those Homtong-banana, as presented in Fig. 6(b). Lefort et al. [9] reported that the density of internal structure affected on texture of puffed potato chip. The higher density structure of fresh potato variety provided harder texture of puffed product. In addition, the colour of puffed products were different between them, Numwa-banana had less brown colour than Homtong-banana in all puffing temperature level, it presented in Fig. 5. Therefore, the Numwabanana had significantly lower ΔE value than those Homtong-banana, as present in Fig. 6 (d). This is because the amount of monosaccharide contains in Numwabanana was lower significantly. Tabtiang [14] reported that the amounts of glucose and fructose in Numwabanana (20-23^{0}Brix) were 1.55 and 1.61 g/100 g of fresh banana, respectively. In addition, Raikham [15] reported that the amounts of glucose and fructose in Homtongbanana (17-18^{0}Brix) were 3.38 and 4.88 g/100 g of fresh banana, respectively. It should be noted that the high amount of monosaccharide in Homtong-banana caused sensitive colour change as increasing puffing temperature.

CONCLUSION

The puffing temperature, puffing time were strongly influenced on banana quality. Higher puffing temperature and longer puffing time caused higher degree of volume expansion, lower hard texture and more crisp texture. However, higher puffing temperature and longer puffing time provided more browning colour of puffed product, as indicated by lower value of L and hue angle. In addition, banana variety significantly affected on product quality. Numwa-banana had harder texture than those Homtong-banana. However, the colour of puffed Numwabanana was better than those ones. This is due to the amount of monosaccharide in Numwa-banana was lower significantly.

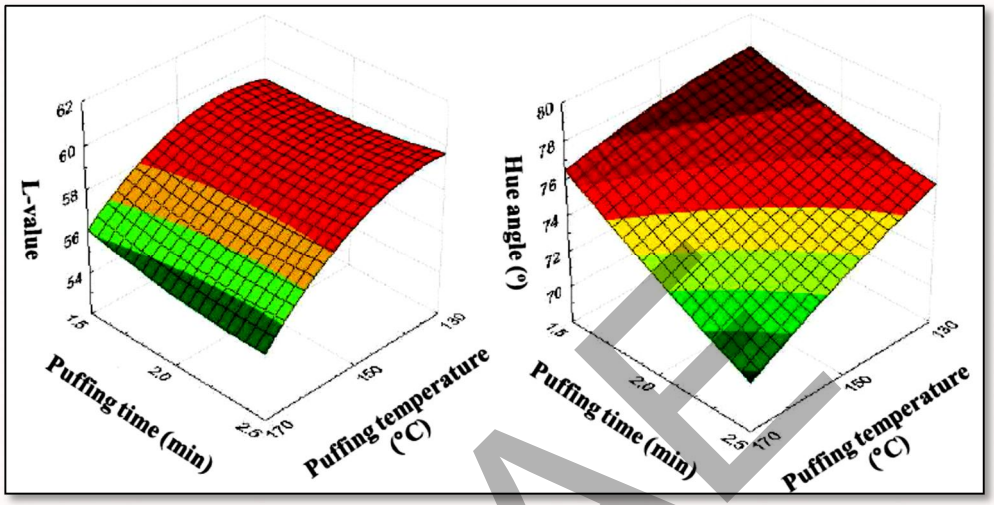

Fig 4. Effect of puffing temperature and puffing time on L-value and hue angle of Numwa-banana.

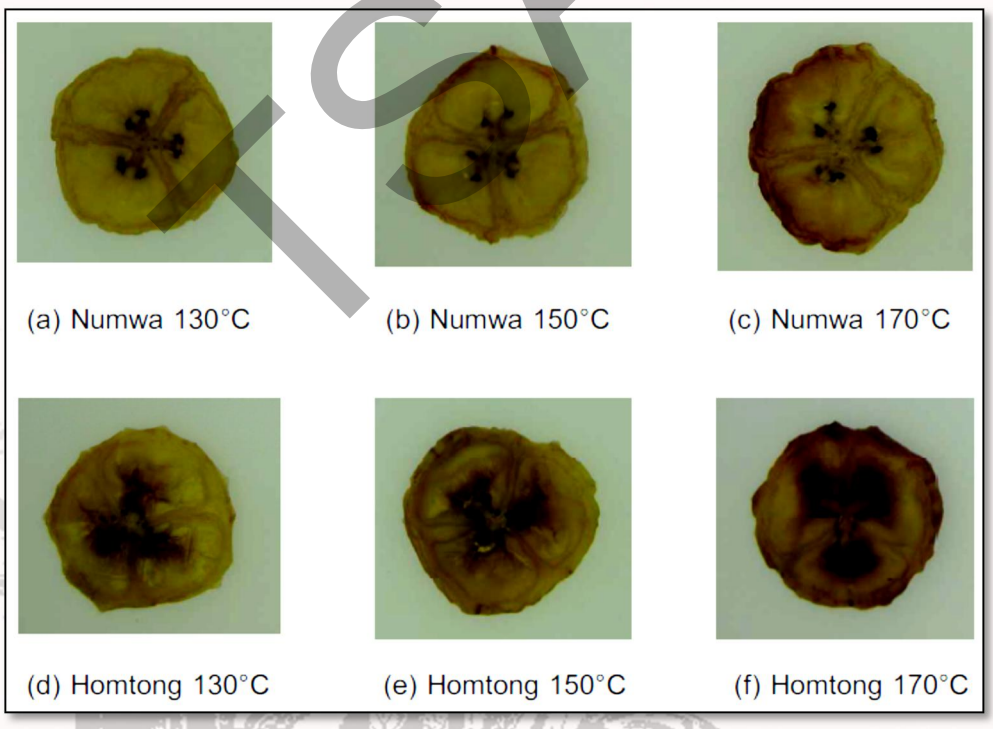

Fig 5. Effect of puffing temperature on colour of Numwa-banana ((a), (b), (c)) and Homtong-banana ((d), (e), (f)).

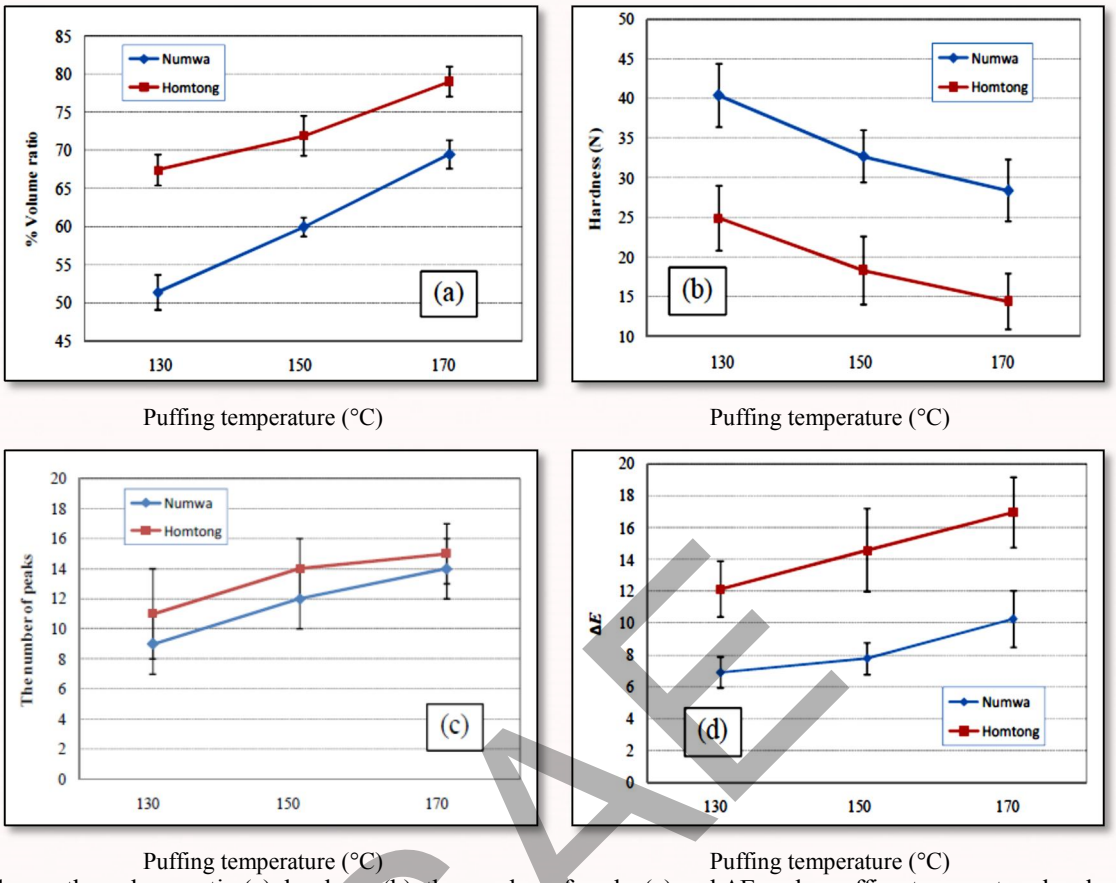

Fig 6. Change the volume ratio (a), hardness (b), the number of peaks (c) and ΔE under puffing temperature level: (◆) Numwa-banana; (■) Homtong-banana.

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