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Effects of moisture heating and vacuum fry on organic and conventional okra quality

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Abstract

Consumers are becoming more concerned with food quality. They perceive organic food as being of better quality, healthier and more nutritious benefits than foods that are produced by conventional methods. Several research studies report that the organic foods contain more bioactive compounds than conventional products. Processed okra is an important agricultural product in Nakhon Pathom (Thailand) and has not yet been studied in this way. During processing, many of important quality compounds in okra maybe lost. The aim of this study was to observe the effect of processing by moisture heating and vacuum frying on the quality of organic and conventional okra. Moisture heating was investigated by blanching the okra at 100 °C for 3 minutes, while vacuum frying involved frying the okra at 100 °C for 20 minutes. The quality of organic and conventionally grown okra was compared before and after processing. Quality attributes included texture, color, moisture, carbohydrate, protein, fat, ash, pH, fiber, total soluble solid (°Bx), total sugar, beta-carotene and vitamin C. The blanching treatment increased the fiber and beta-carotene content, while the carbohydrate, protein, fat, ash, pH, °Bx, total sugar and vitamin C levels decreased after processing. The rate of vitamin C loss from the organic okra was less than in conventional okra, i.e., 14.2 and 58.1 (% wet basis). While the rate of beta- carotene increase in organic okra was higher than conventional okra, i.e., 10.1 and 4.9 (% wet basis). The vacuum frying treatment reduced the physical and chemical quality of okra, but increased beta-carotene content. In addition, the rate of protein, fiber and vitamin C loss from the organic okra were lower than those in conventionally grown. In conclusion the results show that the processing affects to the chemical quality of organic okra less than conventionally grown okra. The rate of quality decline was lower in the blanching processing treatment, especially vitamin C content, while the vacuum fry processing preserved the highest of beta-carotene content.

Keywords: organic okra; conventional okra; vacuum fry; moisture heating; organic quality

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is an important economic vegetable in Thailand where approximately 5,288 rais (8.46 km²) is cultivated. The main export markets for Thai grown okra are Europe, USA and Japan with a value of about 330 million baht per year [1]. Okra in Thailand is cultivated by both organic and conventional farming systems. Several studies have shown that the organically produced foods can contain more bioactive compounds such as flavonoids, total phenolics, beta-carotene, vitamin C, lycopene and antioxidants than conventionally produced products [2][3]. Vacuum frying is a process that can be used to improve the quality of fried food by using pressure to evaporate water at lower than 100°C and minimal exposure to oxygen [4]. Blanching is moisture heating that processes at 80-100°C for several minutes, and then is immediately cooling down nearly room temperature [5]. Its objective is to inactivate enzymes. However heating can reduce the nutritional value and flavor of foods for example vitamins, minerals and soluble nutrients [6] [7] and bioactive compounds can also be lost during processing. Many studies have shown that beta-carotene content was declined while vitamin C content was increased when carrot was fried via vacuum system [8]. Blanching has been shown to reduce vitamin C content and their antioxidant properties in green leafy vegetables [9]. The aim of this study is to examine the effect of blanching and vacuum fry on the physical and chemical quality changing in organic and conventionally grown okra.

Materials and Methods

Raw materials

Organic okra was produced at Rangsit Farm, Pathumthani province in Thailand and cultivated on clay soil with the compost from cattle.

Conventional okra was produced in Banglen Amphor, Nakhon Pathom province in Thailand and cultivated on the combination of clay and sand with commercial chemical fertilizer (46-0-0).

These two okra samples were harvested and transported (4 hours and 10°C then held in polyester bags and placed in polystyrene container with the dry ice.

Effect of moisture heating on okra quality

Okra was blanched at 100°C for 3 minutes [10], after which they were immediately immersed into the cold water for 2 minutes. Compare the quality of organic and conventional okra in both of before and after blanching. Okra quality was assessed for physical and chemical parameters.

Physical quality was assessed by firmness by using texture analyzer (model TA-XT2, Stable Micro Systems, Surry, UK). The firmness value was measured using a cutting probe (HDP/BSW model). Color (CIEL*, a*, b*) is determined by Hunter lab machine (Miniscan XE plus model). Data were analyzed by using Analysis of Variance (ANOVA). A Duncan's New Multiple Range Test was used to determine the difference among sample means at p = 0.05. The experiments were repeated 3 times [11].

Chemical quality was assessed by measuring moisture, carbohydrate, protein, fat, ash, pH and fiber [7], total soluble solid ($^{\circ}\text{Bx}$), total sugar, beta-carotene [12] and vitamin C [13]. Data were analyzed as 1.2.1

Effect of vacuum frying on okra quality

Okra was fried by vacuum frying processing at 100°C for 20 minutes. The quality of organic and conventional okra before and after vacuum frying were assessed by comparing the physical and chemical quality parameters as described in 1.2.1 and 1.2.2.

Results and Discussion

Effect of moisture heating on organic and conventional okra quality

The physical quality of before and after blanching of organic and conventionally grown okra is presented in Figure 1. The results show that for both before and after blanching, the organic okra had higher firmness than conventionally grown okra, and maybe due to a higher fiber content [5][14]. After blanching, the color of the conventional okra became darker (brightness value (L^*) ie, decreased, while the value of 'green-ness' (a^*) and the yellow (b^*) significantly increased ($p \leq 0.05$). It could be argued from the dark green color of the starting material (chlorophyll) and when it was processed chlorophyll it will turn brown-green color to pheophytin [5].

The chemical quality of both types of okra decreased when they were blanched (Figure. 2) except beta-carotene content increased. This maybe due to either carotenoid - protein complex changing [5] or transform during isomerization [15]. The result conforms to [16] that explained beta-carotene retention after boiling might be attributed to either texture of the leave and/or the occurrence of carotenoids in complexes with protein in the plants. The chemical quality results demonstrated that the blanched organic okra was of better quality, by not only a lower decline in vitamin C loss but also more increasing levels of beta-carotene. The results in Table 1 shows declines in vitamin C is 14.7 and the increasing rate of beta-carotene is 10.1 (% wet basis), whilst conventionally grown okra showed a declining rate of vitamin C and the increasing rate of beta-carotene of 58 and 4.9 (% wet basis), consecutively.

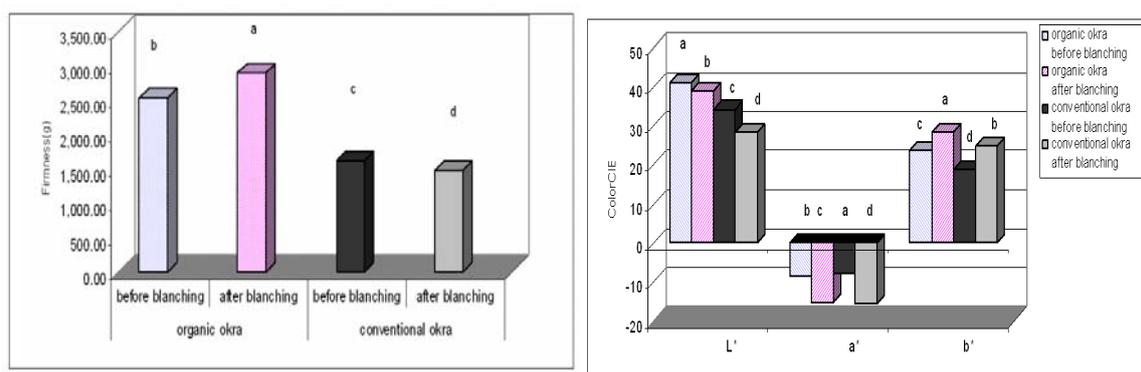
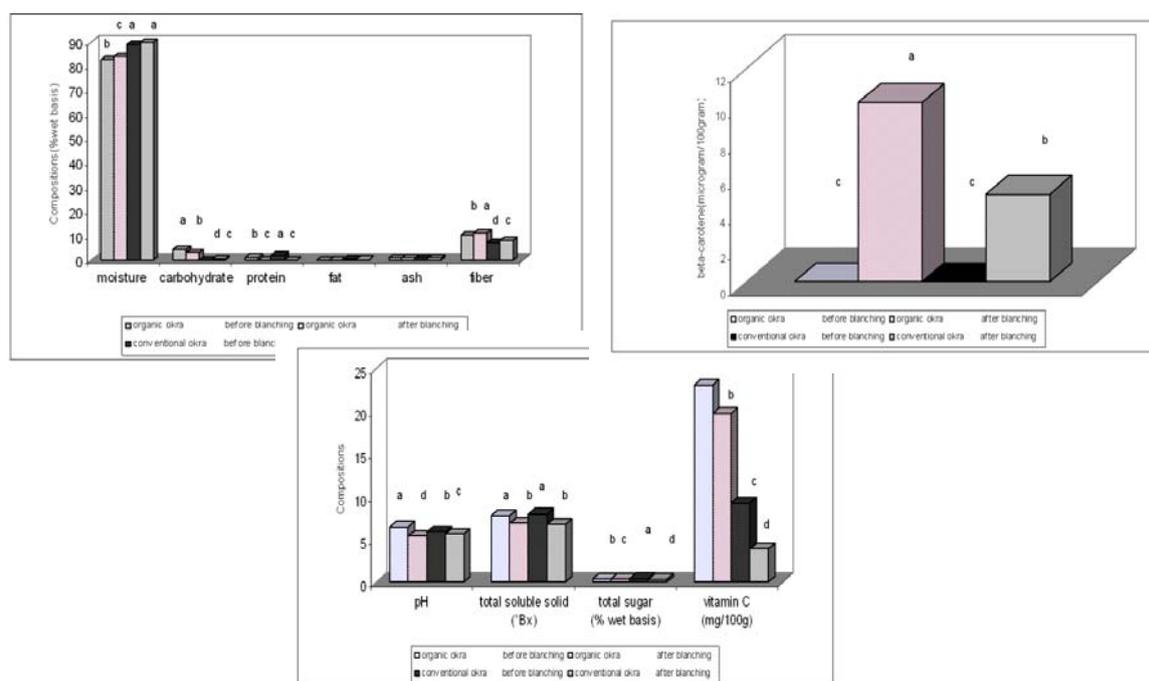


Figure. 1 Physical quality of before and after blanching of organic and conventionally grown okra (a) firmness (b) colorCIE.

Table 1. Percent change in the chemical quality of organic and conventionally grown okra before and after blanching (expressed as % wet basis)

	Organic	Conventional
Fiber (% wet basis)	+ 8.7	+ 10.80
beta-Carotene (% wet basis)	+ 10.1	+ 4.92
Vitamin C (mg/100g)	- 14.7	- 58.1

sign of - means decline, + means increase

**Figure. 2** Chemical quality of before and after blanching of organic and conventionally grown okra (a) moisture, carbohydrate, protein, fat, ash and fiber content (b) beta-carotene content (c) pH, total soluble solid, total sugar and vitamin C content.

Effect of vacuum fry on okra quality

After vacuum frying, the organic okra contained more firmness and was less 'swarthy' in color than conventionally grown okra (Figure 3). This maybe explained by the conventionally okra containing more chlorophyll and protein than the organically grown okra, thereby after frying, the browning color in the conventionally grown okra might be due to stronger Millard reactions [17].

The chemical quality of both types of okra decreased when they were vacuum fried, except the levels of beta-carotene and fat which increased (Figure 4). This maybe due to the palm oil which used for frying is also abundant beta-carotene [17] [18]. During the vacuum fry process, an oil absorption mechanism may have taken place [19], so these chemical contents would be increased.

The vacuum frying process decreased the physical and chemical quality of okra, but increased beta-carotene content. Moreover, the results expressed that declining rates of protein, fiber and

vitamin C of the organic okra are less than those of the conventionally grown okra (Table 2), i.e., 11.5, 16 and 47 (% wet basis), meanwhile the conventional okra were 52, 35 and 74 (% wet basis).

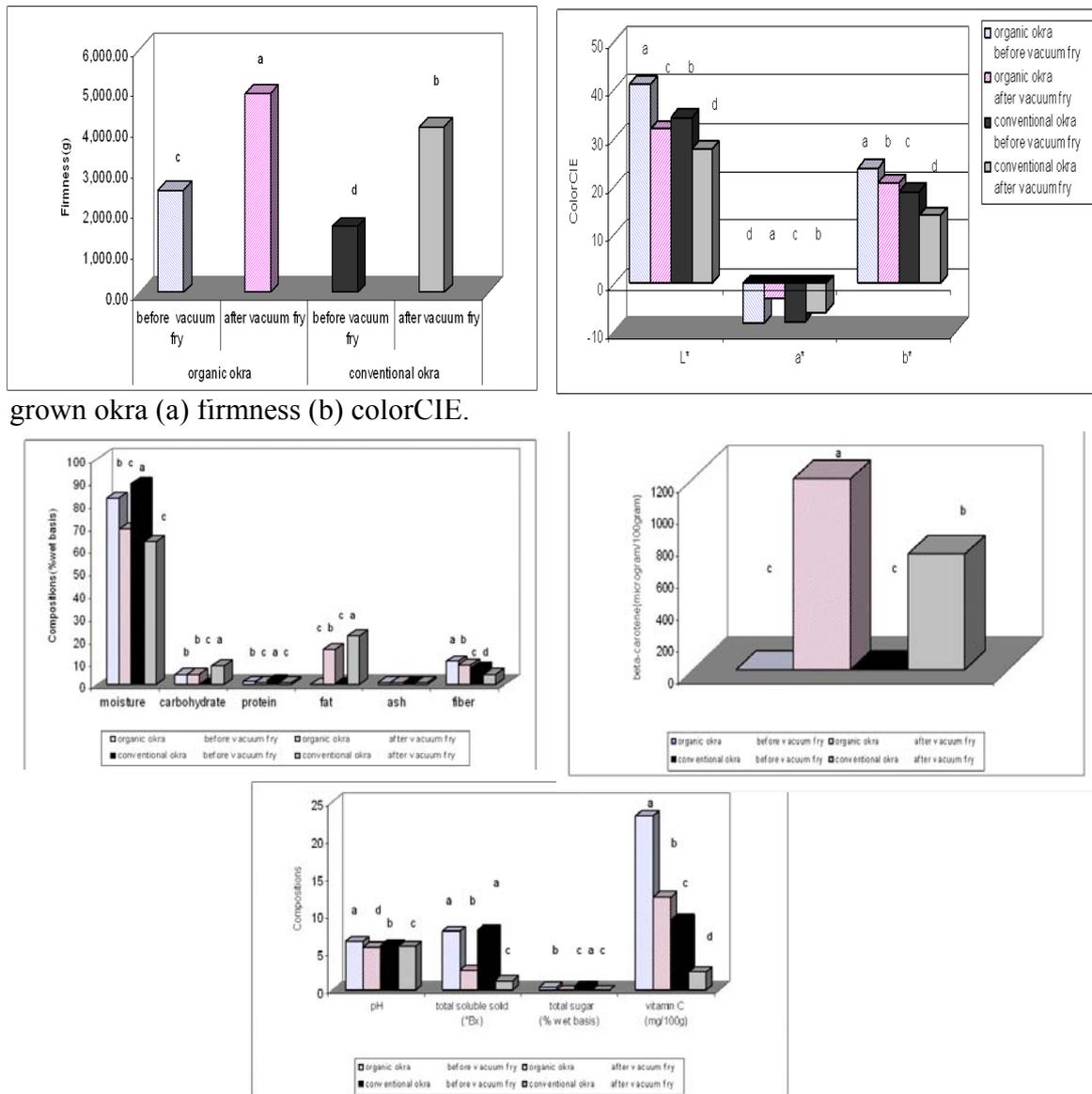


Figure. 4 Chemical quality of before and after vacuum fry of organic and conventionally grown okra (a) moisture, carbohydrate, protein, fat, ash and fiber content (b) beta-carotene content (c) pH, total soluble solid, total sugar and vitamin C content.

Table 2. Percent change in the chemical quality of organic and conventionally grown okra before and after vacuum frying (expressed as % wet basis)

	Organic	Conventional
Protein (% wet basis)	+11.5	+52
Fiber(% wet basis)	-16	-35
beta-Carotene (% wet basis)	+1,196	+ 724
Vitamin C (mg/100g)	-47	-74

sign of - means decline, + means increase

Conclusion

The results showed that the moisture heating and vacuum fry processing affected both the quality of both types of okra. The processing appeared to affect the chemical quality of organically grown okra less than conventionally grown okra, especially the vitamin C and beta-carotene contents. The rate of chemical decline was lower with the blanching process, especially the vitamin C content, whilst vacuum frying resulted in the highest levels of beta-carotene. However the okra used in this research came from different cultivation places and therefore the growing area, environmental conditions and climate where the different okras grew may partially affect to those of physical and chemical qualities. Therefore this work needs to be repeated with okra from the same location to truly compare organic and conventionally grown okra.

Acknowledgements

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