

Nitrate content antioxidant and microbial safety of organic, pesticide free and conventional vegetables in Nakhon Pathom Province, Thailand

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Abstract

Presently, Thai has faced the health problems, e.g., cancer and food contamination. This has induced Thai turns to consume healthy foods, especially, organic natural products. However, the major problem of consumer is lack of knowledge on the nutrition and microbiology of organic natural products, e.g., fresh organic vegetables. The knowledge in Nakhon Pathom has been not yet investigated by any study before. The research aims to investigate the antioxidant, nitrate and food safety among 3 types of vegetables, e.g., (a) organic-, (b) pesticide free- and (c) conventional vegetables which are sale on markets in Muang, Nakhon Pathom. The investigation collected the different 3 types of vegetable samples in the markets in Muang, Nakhon Pathom during October 2010 till September 2011. The sampling collected 6 vegetables, namely, (a) pumpkin, (b) morning glory, (c) kale, (d) cowpea, (e) cabbage and (f) tomato. Each vegetable composed of 3 types, namely, organic, pesticide free- and conventional vegetables. In total, the investigation collected 18 samples. The study induced the analysis on vitamin c, beta-carotene, phenolic, nitrate, DPPH and microorganism safety. The results disclosed that the organic vegetable contained almost of all analyzed parameters significantly more than pesticide free and conventional vegetable samples. Meanwhile, the organic and pesticide free vegetable showed they are more micro-safety rather than conventional one.

Keywords: organic vegetables, pesticide free vegetables, conventional vegetables, antioxidant compound, microorganism

1. Introduction

Thai has faced the health problems from the Non-Communicable diseases (NCD), e.g., cancer, obese or food borne decease. A main influence factor of NCD is due to consuming unsafely food from the conventional vegetables which contains of lower nutrition gradient and more pesticide/chemical fertilization contamination [1]. From this situation, the Thai consumer turns his/her face to consume more safety fresh food rather than the processed food. From the literature reviews, there are international studies disclosed that organic vegetables contains of more antioxidant contents, namely, vitamin c, phenolic and antioxidant matter more than the conventional one [2-4]. This result conforms to the study in Thailand [5] which was conducted the investigation of comparing antioxidant capabilities between the organic- and conventional vegetables, namely, white cabbage, kale, morning glory, Chinese kale and cow pea in the Northern Thailand. The result showed the organic vegetable has more antioxidant capabilities more than the conventional one. Furthermore, the literatures showed that there are micro-contaminations, namely, *E. Coli* in the conventional vegetables [6], but the truth still be in doubt as the consumers were not know the date of local vegetables. All above mentioned studies, they have never been conducted in Nakhon Pathom Province, Thailand, before. Therefore Nakhon Pathom consumers do not know yet about the merit of consuming the organic or pesticide free vegetables. From this reason, the research project, thus, was to monitor the secondary compounds, DPPH and nitrate content including microorganism of food safety, in order to induce providing the merit of consuming organic or pesticide free vegetable.

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2. Materials and methods

2.1 Raw material

Certified organic, pesticide free and conventional vegetables were collected for 1 time per every month in a year (October 2010 till September 2011). The vegetables were collected from 4 main markets where these vegetables are available in Nakhon Pathom Province (Soi2 morning market, modern trade, Doi Kam shop and Patom mongkol market), Thailand. Ten kilograms per sampling lot of vegetables were transported and kept at 10 °C in polyethylene bag in a cool box to the laboratory. The aim of this sampling was to obtain a real set of samples that would be representative of the organic, pesticide free and conventional vegetables available in a year in Nakhon Pathom Province during the time of the study. From this sampling, 6 representative vegetables are pumpkin, morning glory, kale, cowpea, cabbage and tomato. Information upon sampling vegetables is present in Table 1.

2.2 Antioxidant and nitrate determination

The edible part of each vegetable was determined except pumpkin which the skin was peeled 80% according to the commonly consumed. Vitamin C content was analyzed according to AOAC 2000 standard [7] method. The beta-carotene, total phenolic content and DPPH assay were determined according to method of Nagata and Yamashi (1992), Singleton and Rossi (1965) and Brand-William (1995) [8-10] respectively. Nitrate content was conformed by using TMC-103 standard method for water and waste water analysis. The experiment was designed as completely randomized design with 3 treatments each vegetable, i.e., organic, pesticide free and conventional vegetables. The results reported as mean ±SD with 3 replications. The mean differences were analyzed using ANOVA and Duncan's New Multiple Range Test [11]. The Differences were considered significant at $p < 0.05$.

2.3 Microbial analysis

The edible part of each vegetable was determined Total aerobic bacteria, yeast and mold according to [7]. *E.coli* and *Salmonella* sp. were monitored by [12] method. The results interpreted comparing with the criteria of microbiological quality and food contact containers Act (c.2) 28 September 2010 of the Department of Medical Sciences, Thailand.

3. Results and discussion

3.1 Antioxidant and nitrate content in organic, pesticide free and conventional vegetables

The comparisons of antioxidant and nitrate contents were shown in Figure 1 and 2. Vitamin C is a strong antioxidant property which has been reported that reduced the risk of cancer, coronary disease, inhibition of the LDL oxidation [13]. Vitamin C in the present monitoring as shown in Figure 1a found that all organic vegetables (pumpkin, morning glory, cowpea, kale, cabbage and tomato) having the highest quantity than those in pesticide free and conventional vegetables. This may be caused from the organic farming system is the holistic agriculture which focusing especially soil fertility and soil mineral utility. Furthermore, the plant cultivated from the organic system was stressed and produced more antioxidant compounds. The result was in accordant to [14] who reported that organic vegetables had higher vitamin C content than conventional one.

Beta-carotene is a primary source of vitamin A and also is the most abundant in plant. The amounts of beta-carotene in the samples ranged from 2 mg/g to 170 mg/g, are presented in Figure 1b. organic and pesticide free of Pumpkin (47 mg/g and 170 mg/g), morning glory (54 mg/g and 76 mg/g), cowpea(26 mg/g and 23 mg/g) and tomato(18 mg/g and 14 mg/g) contained the highest amounts of beta-carotene. Cabbage (2 mg/g in average value) has the lowest beta-carotene value.

The total phenolic content as shown in Figure 1c showed that non-significant value between organic, pesticide free and conventional pumpkin, kale, cabbage and tomato. Organic morning glory (1.52 mg/g) had total phenolic content higher than this in pesticide free (1mg/g) and conventional (0.8 mg/g). The result was conformed to [5] who argued that the highest content of total phenolic was found in organic morning glory. That total phenolic content was not in accordant to the result from cowpea which conventional cowpea had highest value than others.

DPPH is the radical scavenging assay to show the capability of antioxidant catch with a stable free radical (DPPH).The result showed in Figure 1d revealed that 4 organic and pesticide free vegetables (pumpkin,

morning glory, cabbage and tomato) had higher DPPH value than those in conventional. Whereas DPPH values of kale and cowpea had no different among organic, pesticide free and conventional. The data might be argued and conformed to [16] whom reported that vitamin C and secondary compounds content had higher in organic than convention vegetables, especially in morning glory [5].

Nitrate is the compound which metabolized from nitrogen fertilizer. It might be connected to be toxin and cancer in human and animal body [1]. Organic vegetables had lowest nitrate value especially in morning glory (50 mg/kg). Conventional kale had highest nitrate value (3400 mg/kg).

Table 1 Organic, pesticide free and conventional vegetables available in Nakhon Pathom, Thailand during October 2010 to September 2011

| Name | Periods (October 2010 to September 2011) | | | | | | | | | | | |
|---------------|--|------|------|------|------|------|------|-----|------|------|------|------|
| | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. |
| Pumpkin | ✓ | | | | | | | | ✓ | | ✓ | |
| Morning glory | | ✓ | | ✓ | | | | ✓ | | | | |
| Cowpea | | | ✓ | | | | | ✓ | | | ✓ | ✓ |
| Kale | | ✓ | | ✓ | | | | | | ✓ | | |
| Cabbage | | | | | ✓ | ✓ | | | | | | |
| Tomato | | | | | | | ✓ | | | | | ✓ |

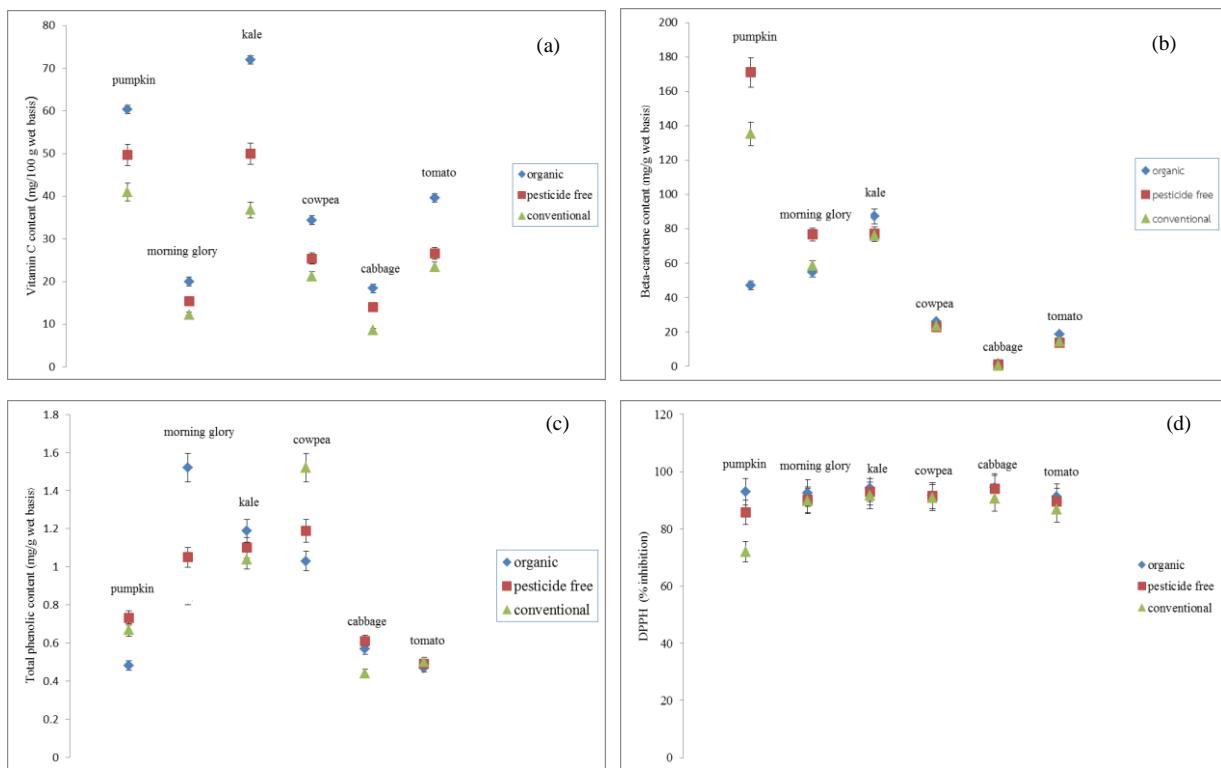


Figure 1 Vitamin C (a), beta-carotene (b), total phenolic content (c) and DPPH (d) of organic, pesticide free and conventional of vegetables

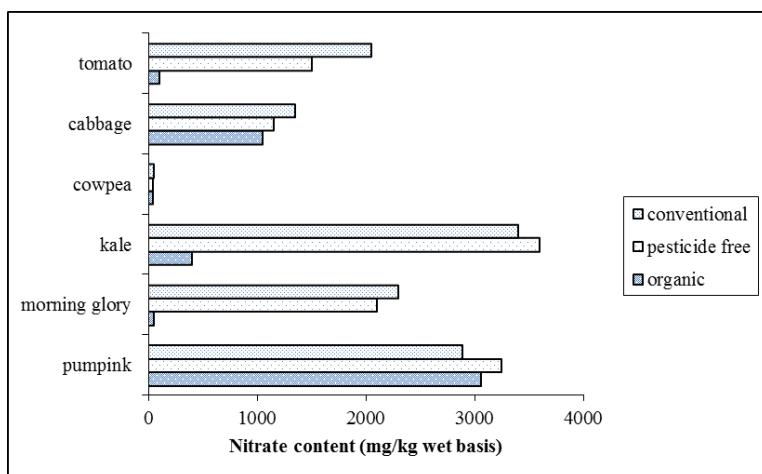


Figure 2 Nitrate content of organic, pesticide free and conventional vegetables

3.2 Microorganism in organic, pesticide free and conventional vegetables

The comparison of microorganism as shown in Table 2 revealed that *Salmonella* sp. was not detected in any kind of vegetables. Total aerobic bacteria of organic, pesticide free and conventional vegetables are almost in standard with exception of conventional cabbage had higher (6.10×10^6 cfu/g). Conventional kale and cabbage had yeast higher (3.88×10^5 cfu/g and 3.72×10^6 cfu/g) than standard meanwhile organic morning glory and kale had highest incidence of mold (560 MPN mold/g and 508 MPN mold/g). *E.coli* contamination were found in all vegetables. The organic and pesticide free vegetables (Pumpkin, morning glory, cowpea and kale) were found *E. coli* <100 MPN/g, while all conventional vegetables were those detected. This result could be due to inadequate hygienic practices during cultivation, pre- and post-harvest handling or sporadic contamination in irrigation water [16]. However, no data concerning the quality of the water was obtained from the origin manufacturing. The data conform to [6] who reported that conventional salad vegetable had higher *E.coli* contamination than those organic vegetable.

Table 2 Total aerobic bacteria, yeast, mold, *E. coli* and *Salmonella* sp. of vegetables

| Name | Type | Total aerobic bacteria (cfu/g) | yeast (cfu/g) | mold (MPN mold/g) | <i>E. coli</i> (MPN /g) | <i>Salmonella</i> sp. |
|---|----------------|--------------------------------|--------------------|-------------------|-------------------------|-----------------------|
| microbiological quality and food contact containers Act | | 1×10^6 | 1×10^4 | <500 | <100 | NF |
| Pumpkin | organic | 3.99×10^5 | 4.83×10^4 | 285 | positive | NF |
| | pesticide free | 4.25×10^5 | 4.96×10^5 | 268 | positive | NF |
| | conventional | 3.16×10^5 | 4.95×10^5 | 455 | positive | NF |
| Morning glory | organic | 6.33×10^5 | 4.73×10^4 | 560 | positive | NF |
| | pesticide free | 5.33×10^4 | 4.83×10^4 | 454 | positive | NF |
| | conventional | 5.37×10^5 | 5.73×10^4 | 370 | positive | NF |
| Cowpea | organic | 2.14×10^6 | 4.15×10^5 | 309 | positive | NF |
| | pesticide free | 2.14×10^5 | 5.02×10^5 | 183 | positive | NF |
| | conventional | 2.34×10^5 | 3.62×10^5 | 500 | positive | NF |
| Kale | organic | 3.85×10^5 | 5.14×10^4 | 508 | positive | NF |
| | pesticide free | 5.06×10^5 | 2.86×10^4 | 483 | negative | NF |
| | conventional | 6.67×10^5 | 3.88×10^5 | 654 | positive | NF |
| Cabbage | organic | 5.75×10^4 | 3.55×10^4 | 170 | negative | NF |
| | pesticide free | 4.70×10^5 | 3.60×10^3 | 135 | negative | NF |
| | conventional | 6.10×10^6 | 3.72×10^6 | 410 | positive | NF |
| Tomato | organic | 3.67×10^5 | 4.1×10^3 | 120 | negative | NF |
| | pesticide free | 4.15×10^5 | 1.56×10^3 | 227 | positive | NF |
| | conventional | 2.33×10^5 | 1.92×10^3 | 252 | positive | NF |

NF means not found

Positive means *E.coli* >100 MPN/g

Negative means *E.coli* <100 MPN/g

4. Conclusions

Base on this study, most organic vegetables available from Nakhon Pathom contain higher vitamin C content than conventional and pesticide free vegetables and exhibit potent antioxidant activity as assessed by DPPH, whereas, lowest nitrate content. Beta-carotene content in pesticide free trend higher than conventional vegetables, meanwhile the total polyphenol content in organic, pesticide free and conventional vegetables were not significant different. The result is the sampling vegetables which were available in the market, so the variation value of antioxidants and nitrate might arise from the variety of the plant, stage of ripening, place of cultivation, climate condition, fertilization, transportation, pre and post-harvest handling, sample preparation and methods of analysis. *Salmonella* sp. was not detected. The conventional vegetables had higher *E.coli*. than organic vegetables. The data can be used to be information to increase the consumption of organic and pesticide free in local community.

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