Comparison of Iron Absorption – Inhibited Substances in Local Thai Vegetables

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ABSTRACT

Seventy-five samples of local Thai vegetables which popularly consumed as fresh vegetable are chosen from various menu foods. They are selected and classified into direct components in food dish, eg. *Som tum, Kua yum* etc, including consumed as fresh vegetable together with chilli paste such as *Nuam prig*. In report of analysis, the iron absorption - inhibited substances of various local vegetables which take to balance iron are 114.46–244.66 mg of phytate 100 g 455.72–1407.23 mg of oxalic acid 100 g 209.60–528.90 mg of phosphate100 g 175.03–453.06 mg of tannin100 g and 1.0852–2.7273 g of crude fiber100 g by statistical interval estimation (minimum – maximun) at 95% confidence level. In part of edible vegetables, they are found that fruit group has crude fiber content more than the others while edible leaf group has high oxalic acid and tannin content. Tannin of creeper, herb and tree which are orderly average 240, 314 and 584 mg/100g have significantly difference by statistic at $\propto$=0.01. Comparison on Pearson 's correlations between oxalic acid with phosphate and tannin with phosphate are $Rxy = 0.77$ and 0.598 respectively at 99% confidence level.

Key words: local Thai vegetable, iron bioavailability, risk chemicals

INTRODUCTION

Culture of food consumption is different in each part of Thailand but the common consumption behaviour is a usage of fresh vegetable in food menu. Although fresh vegetables are useful in healthiness and medicinal properties, they are also related to the ferric absorption – inhibited substance. Ferric absorption – inhibited substances which are the risk agents are various such as phytate, phosphate, crude fiber, tannin and oxalic acid. Risk agents affect the ferric absorption and decrease iron utility. Risk agents affect directly to the iron bioavailability. Iron element is a mineral necessitates the red blood cell formation. In the statistical report of anemia, Asian has high rate of anemia caused by iron deficiency. Consumptions of limited amount of iron and of high risk agents resulted in obtaining less iron.

METERIALS AND METHODS

Local Vegetables : Selection and Sampling

The samples of local vegetable which are favorably consumed as fresh vegetable were selected from various menu of foods in each part of Thailand. They were investigated and identified before the analysis of risk factor chemicals.

Characteristics of Local Thai Vegetables

Botanical characteristics of plant were classified by morphological characteristics, for

example, kinds of leaf, shape, apex, base, and margin were recorded, including the average weight, width, size, longivity per sample unit and picture of sample.

Sample Preparation

Local vegetable samples were separated an edible part by peeling and cutting a stalk. All edible parts of selected vegetables were cut into the small pieces and blended to homogenize the sample. If vegetables had lower moisture content the known amount of distilled water was added to make a slurry. This amount of water was calculated for the real weight of fresh vegetable. The sample was further analyzed.

Analysis on contents of risk agents to the iron absorption

Analysis of phytate was done by mean of anion exchange method (AOAC, official method 974.27). Vegetable sample was extracted with HCL 2.4 **%**, and then extractable solution was added with EDTA / NaOH and eluted thorough an ion exchange column by 0.7 M NaCl. Eluted solution was digested into a free phosphorous by mixture of HNO_3 and H_2SO_4 and formed a blue compound by molybdate solution and sulfonic reagent. Blue compounds were measured an absorbance and calculated to compare with standard solution of phytate.

Analysis of crude fiber used AOAC. official method 930.10 by method of ceramic fiber filter. Vegetable sample was digested with 1.25% H_2SO_4 and 1.25% NaOH respectively. Digested fiber was calculated based on dried weight basis. After that they were ashed to separate a mineral and crude fiber was calculated.

Tannin was analysed by spectrophotometer as indicated in AOAC. official method 952.30. Extracted solution was filtered and formed a complex compound between tannin and Folin-Denis reagent. After that blue color compounds were determined an absorbance at wavelength of 760 nm.

Quantitative phosphate was analysed by method of molybdovanadate spectrophotometer (AOAC, official method 970.39). Golden - yellow of complex compound was determined by UV-Visible spectrophotometer at wavelength of 470 nm.

Oxalic acid was analysed by mean of High Performance Liquid Chromatography (HPLC) by purification with a reverse phase column and measured with UV-Visible spectrophotometer detector. Extracted solution was filtered with 0.45 μ membrane filter before injection into HPLC. And then they were eluted by 0.2% acetic acid : water (99.9 : 0.1). Oxalic acid was calculated comparing with the calibration cruve of oxalic acid standard and blank.

Statistical Analysis

Maximum and minimum of average value was analysed t–test of Statistical Package for Social Science Program (SPSS). Difference in groups and between all of groups were evaluated by F–test. Relationship of sample in each group was calculated by Pearson's correlation. Relative value was reported in terms of correlation coefficient (Rxy).

RESULTS AND DISCUSSION

Distinction on characteristics of local Thai vegetable samples were confirmed for the origins. The contents of iron absorption inhibitor in each local vegetable were analysed by SPSS program. Average value of each inhibitors was estimated (minimum – maximum) by statistics at 99% confidence level was shown in Table 1.

Seventy - five samples of local vegetables which were favourable consuming as fresh vegetable were analysed for iron absorption inhibitors. They were found that average values of crude fiber, phosphate, phytate, tannin, and oxalic acid had statistically significant difference at p-

value of 0.01.

The result of analysis showed that the iron absorption - inhibited substances in 100 grams of various local vegetables were 114.46–244.66 mg of phytate, 455.72–1407.23 mg of oxalic acid 209.60–528.90 mg of phosphate 175.03–453.06 mg of tannin and 1.0852–2.7273 g of crude fiber by statistical interval estimation (minnimum – maximun) at 95% confidence level.

Local Thai vegetables were classified into three groups. There were leaf edible group, fruit edible group and another edible part of vegetable group (Figure 1).

In part of edible vegetables, they were found that leaf group had the highest tannin content (Figure 2). Fruits group had crude fiber more than the others, while leaf group had the highest oxalic acid and tannin. Crude fiber, phosphate, phytate, tannin and oxalic acid of each edible part of local Thai vegetables had significantly difference by statistic of p – value of 0.01.

When vegetables were classified as creeping, herb and tree, there were significantly difference of tannin content at p – value of 0.01. The average of tannin content of these 3 group were 240, 314 and 584 mg/100g respectively.

Relationship of risk agents content in local vegetable was found that they had be significantly related at 95% confidence level by Pearson's Correlation method. Tannin is related to both phosphate and oxalic acid at correlation Rxy=0.77 and 0.497 while oxalic acid is related to both phosphate and phytate at correlation Rxy=0.598 and 0.406.
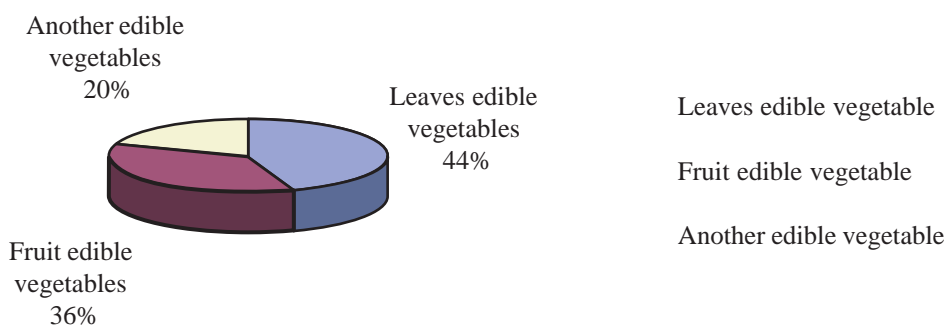

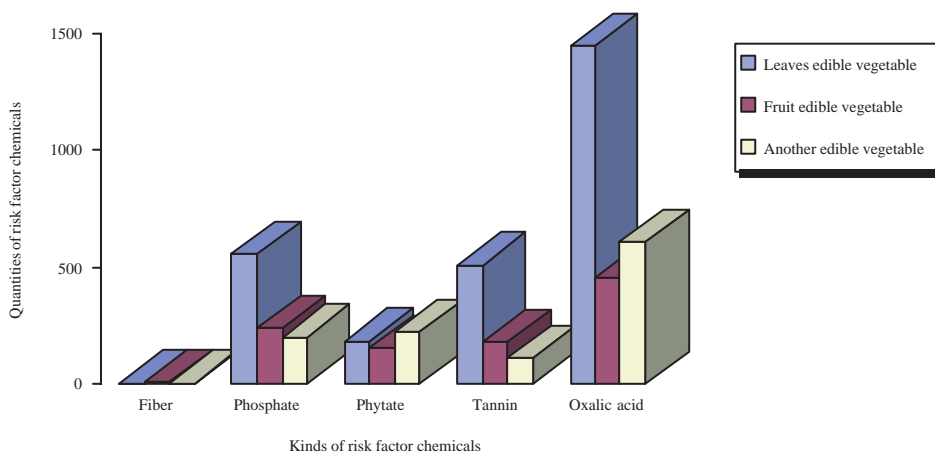**Figure 1** Percentage of each edible vegetables by sampling selection.

Figure 2 Content of iron absorption inhibitors in vegetable groups.

According to the exchanged list the American Dietetic Association, vegetable intake was recommended about 3-4 serving per a day. From this recommendation, the amount of iron absorption inhibitor was calculated as indicated in Table 2.

In addition, Table 3 showed the list of vegetables contained high amount of iron inhibitors such as *tender tips of Horse-tamarind, Coral leave, Caraway, Wildbetal leaves, Water mimosa, Seed*

Table 1   Contents and average values of risk agents in local vegetables.

Risk agents	Average value of interval estimation at 99% confidence level	
	Lower	Upper
Crude Fiber (%)	1.0852	2.7273
Phosphate (mg/100g)	209.61	528.90
Phytate (mg/100g)	114.41	244.66
Tannin (mg/100g)	175.13	453.06
Oxalic acid (mg/100g)	455.72	1407.23

Table 2   Amount of obtainable risk agents from vegetable consumption 3-4 serving per a day.

Risk agents	Risk of quantitative consumption per day
Crude Fiber (g)	5.7186 - 9.531
Phosphate (mg)	1107.764 - 1846.274
Phytate (mg)	538.6029 - 897.6715
Tannin (mg)	942.1404 - 1570.234
Oxalic acid (mg)	2794.412 - 4657.354

Table 3   Ten ordinary kinds of vegetables with high content of iron inhibitors.

Phosphate	Phytate	Tannin	Oxalic acid
Horse-tamarind,seed	Banana,flower	Taew	Horse-tamarind,seed
Taew	Plate brush egg plant	Horse-tamarind,seed	Pak-chee-lao
Neem tree,tender tips	Pepromia	Taew,white	Taew
Taew,white	Nitta tree seed	Caraway	Plate brush egg plant
Okra,young pod	Cha muang	Neem tree,tender tips	Banana,flower
Coral,leaves	Djenkol beans	Coral,leaves	Wildbetal,leaves
Caraway	Wildbetal,leaves	Water dropwort	Horse-tamarind,tender tips
Acacia pennata,tips	Coral,leaves	Water mimosa	Taew,white
Plate brush egg plant	Horse-tamarind,tender tips	Horse-tamarind,tender tips	Celery
Nitta tree seed	Leech lime,leaves	Leech lime,leaves	Water mimosa
Horse-tamarind,tender tips	Onion,small	Acacia pennata,tips	Caraway
4	3	2	1

4,3,2 and 1 mean the number of high risk agents in ten ordinary number of vegetables

of Horse-tamarind, Banana flower,Taew, tender tips of Horse-tamarind etc.

CONCLUSION

All of local Thai vegetables were favourably consumed as fresh vegetable.They were found that entire vegetables had iron absorption – inhibited substances. Various kinds of vegetable had a very high content. Some had highly a risk agents only. In tradition of food consumption, fresh vegetables were used in various thai food menu. These were shown that people consumed fresh vegetables in all times of meal. Vegtable consumptions affected to amount of obtainable risk agents. In case of less considerations on risk agent as well as a lot of consumptions and carelessness were taken by consumer. They affected iron deficiency. and increasing anemia condition of the risk group. Nowadays, a lot of societies promote mostly on the local vegetable consumption. Consideration and sufficiency on vegetable consumption will help to make the best healthy.

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