

Nutraceutical properties of Thai "Yor", *Morinda citrifolia* and "Noni" juice extract

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Abstract

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Morinda citrifolia Linn. is known in Thailand as "Yor" and commonly called "Noni" in Hawaii, Tahiti and USA. This paper reports the results of chemical analysis of Thai "Yor" (*M. citrifolia*) juice extract. The juice from "Yor" fruit, was found to be high in vitamin C, vitamin B-complex contents (HPLC method), and was also high in anti-oxidants, anthraquinones, flavonoids, saponins and scopoletin (TLC method). Sodium, potassium, calcium, iron and selenium contents of the juice (AAS method) are also reported. All the results of Thai "yor" juice are comparable to those of the commercially distributed 'Noni' juice. The Thai "Yor" juice was free of microorganisms and could safely be consumed in the recommended amount of 30 ml/day. The results of this study only apply to the Thai "Yor" juice preparation. The commercial "Noni" juice may be processed differently and may contain other ingredients.

Key words : Nutraceutical and functional food, *Morinda citrifolia*, Noni juice extract,
HPLC, TLC

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บทคัดย่อ

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เฉลิม จันทรสม และ ชัชชญา สัตพนพันธ์
คุณสมบัติทางเภสัชโภชนาของโมรินดาซิตรีโฟเลียในน้ำสกัด "ยอ" ของไทย
และน้ำสกัด "โนนิ"
ว.สงขลานครินทร์ วทท. 2548 27(ฉบับพิเศษ 2) : 579-586

Morinda citrifolia Linn. หรือ "ยอ" มีชื่อเรียกว่า "โนนิ" ในหมู่เกาะฮาวาย และตาฮิติ การวิจัยนี้รายงานผลการวิเคราะห์ทางเคมีในน้ำสกัดผลยอดด้วยวิธี HPLC พบว่ามีวิตามินซีและวิตามินบีรวมในปริมาณสูง มีสารกลุ่มต้านอนุมูลอิสระ แอนทราควิโนน ฟลาโวนอย ซาโปนิน และสโคโพลेटิน ซึ่งวิเคราะห์ด้วยวิธี TLC และพบว่ามีโซเดียม โปแตสเซียม แคลเซียม เหล็ก และเซเลเนียม เมื่อวิเคราะห์ด้วยวิธี AAS ผลการวิเคราะห์น้ำสกัดยอไทยเทียบได้กับน้ำสกัดที่ผลิตเป็นการค้า "โนนิ" น้ำยอของไทยนี้ปราศจากสารจุลินทรีย์ที่เป็นพิษ และปลอดภัยต่อการบริโภค ซึ่งแนะนำให้ดื่มวันละ 30 มล. ผลการศึกษานี้เป็นผลการรายงานเฉพาะน้ำยอที่เตรียมขึ้นเองนี้เท่านั้น น้ำยอที่ผลิตเป็นผลิตภัณฑ์ทางการค้าอาจมีกระบวนการผลิตที่แตกต่างออกไป และอาจมีการเติมส่วนผสมอื่นด้วย

หน่วยวิจัยสมุนไพรและอาหาร โครงการจัดตั้งศูนย์วิจัย คณะแพทยศาสตร์ มหาวิทยาลัยธรรมศาสตร์ อำเภอดงหลวง จังหวัด
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Nutraceutical and functional food (NFF) products are increasingly becoming health products of choice for the next decade. Nutraceutical (or part of the food) offers medical or health benefits to the consumer by providing a means for the maintenance of health and well being and protection from diseases. A functional food provides the body with the required amounts of vitamins, fats, protein, carbohydrates and many other compounds that are needed for its survival (DeFelice, 2002; Kalra, 2003).

Morinda citrifolia Linn. an Indian mulberry or "Noni" in English, and "Yor" in Thai, is the plant that can be used as a raw material for nutraceutical and functional food products. In Thailand, "Yor" leaves cooked with curry give a wonderful and nutritious dish. "Yor" fruits can be prepared as a Thai traditional salad "Somtumyor". Dried fruits or leaves powder boiled with water produces a tea, which is used to relief blood pressure, muscle pains and vomiting.

There are more than 120 nutraceutical compounds identified in Noni (Solomon, 1999). Noni or Yor juice extract which is obtained from fermented Noni fruits is the most effective product

that has helped relieved people ($n \geq 10,000$) from the suffering of about 22 conditions, such as arthritis, heart disease, diabetes, headache and muscle pain, high blood pressure, cancer, etc. (Solomon, 1999).

Recently 'Noni' juice extract has been commercially processed and distributed internationally as a dietary supplement. Relatively unheard of 5 years ago, *M. citrifolia* has now exploded into nearly a billion-dollar industry.

The objectives of this paper are (1) to determine the nutraceutical components of Thai "Yor" (*M. citrifolia*) juice extract, which was prepared using a Thai traditional method, and (2) to compare the nutraceutical composition of Thai Yor Noni juice extract with the U.S. commercial product.

Materials and Methods

Yor fruits were obtained from several provinces in Thailand, i.e. Phra Nakhon Si Akutthaya, Nakhon Pathom, Nonthaburi, Pathum Thani, Nakhon Ratchasima, Phrae, Saraburi and Surat Thani. The fresh fruits were cleaned by

washing with water. The bioactive Yor juice (BYJ) extract was prepared by mixing the clean and mature fruits with red sugar at the proportion of 3:1 in a glass or stainless steel reactor. The mixture was often stirred during the first period of 2 weeks then left in the reactor until the foul smell of Yor disappeared, which took about 3-6 months. The BYJ extract was separated from the residue by filtering through cotton cloth.

The BYJ extracts were analyzed with High Performance Liquid Chromatography, (HPLC), to obtain the contents of vitamins C and B-complex. HPLC system was composed of Spherisorb S5 ODS2, 25 cm Cartridge, 4.6 mm diameter column and UV-detector at 254 nm with the isocratic mobile phase of 0.05 M sodium acetate, (pH 5.2) acetonitrile and 0.005 M hexanesulfonic acid sodium salt monohydrate (HSA) at the ratio of 60:28:12 (Nandhasri,1986).

The characteristic components of BYJ extract i.e. anti-oxidants, alkaloids, anthraquinones, coumarins, essential oils, flavonoids, saponins, scopoletin and sugars were obtained by TLC

method. (Wagner, 1993 and Wagner, 2000). The mobile phase system, spraying reagents, UV and visible detection results are summarized in Table 1. The microplates for TLC determination were made by dipping a sandwich of micro slide in a mixture of Silica gel 60 G and water at the ratio of 1:1.

Sodium, potassium, calcium, iron and selenium contents were analyzed using Atomic Absorption Spectrophotometric (AAS) method (AOAC, 1995). The quantities of fat, protein, carbohydrate and calories were analyzed using AOAC methods (AOAC, 1995; Pendl, 1998). The microorganisms were analyzed by Bam's method (U.S. FDA., 1998).

Results, Discussion and Conclusion

The results of vitamins analysis in of bio-active Yor juice (BYJ) extract are comparable to those of commercial Noni juice (NJ). The vitamin content in bio-active Yor juice (BYJ) extract was in the range of 38.54-97.64 mg/100 g. It is interesting to note that the vitamin content of BYJ

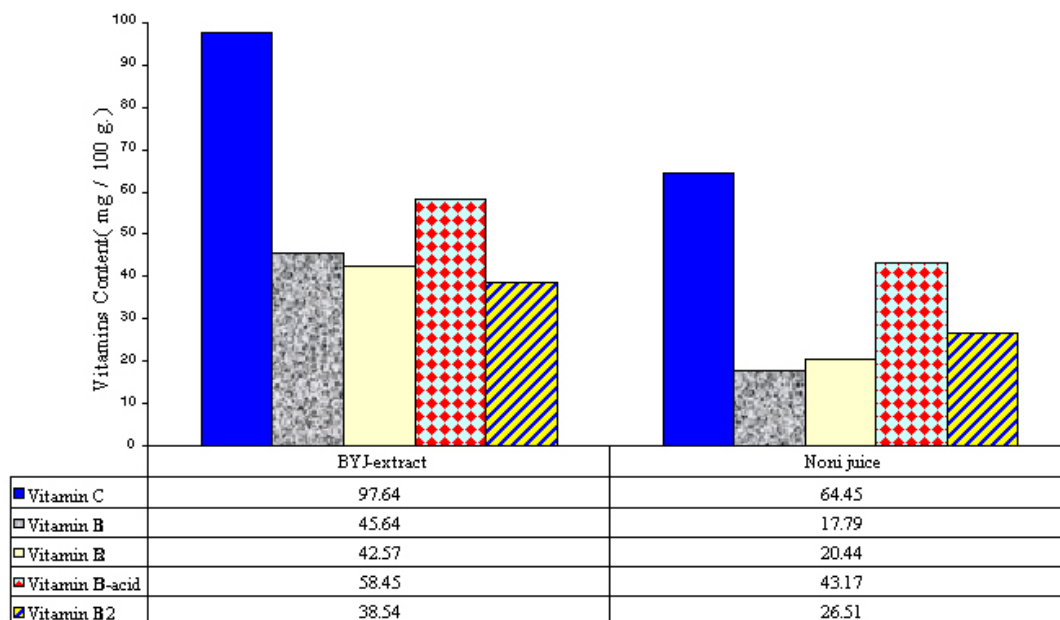


Figure 1. The comparative results of vitamins content: vitamin C, vitamin B₁, vitamin B₂, vitamin B₃ and vitamin B₁₂ in *Morinda citrifolia* L. of Bio-active Yor Juice (BYJ) extract and Noni juice product from abroad (NJ).

Table 1. Thin Layer Chromatography Methods (Wagner, 1993 and Wagner, 2000). Summarized mobile phase system, spraying reagent, and colour result of UV and visible detection.

No.	Test	Extraction	Mobile phase	Spraying reagent	Detection	Result
1	Alkaloids	10 ml methanol+1ml 10% ammonia	Toluene/Ethyl acetate/Diethylamine (70:20:10)	Dragendroff reagent	Visible	orange
2	Antraquinones	10 ml methanol	Ethyl acetate/Methanol/Water (100:13.5:10)	KOH reagent	Visible and UV 366 nm	orange/red
3	Antioxidants	10 ml dichloromethane	Ethyl acetate/Toluene (50:50)	DPPH reagent	Visible	white spot on purple background
4	Coumarins	10 ml dichloromethane	Toluene / Ethyl acetate (93: 7)	1. None	Visible and UV 366 nm	light blue/purple/green
5	Essential oils	10 ml dichloromethane	Toluene / Ethyl acetate 93: 7)	2. KOH reagent Anisaldehyde - Sulfuric acid reagent	UV 366 nm Heat 100°C Visible	Light green pink/purple/red /orange/green/black
6	Flavonoids	10 ml methanol	Ethyl acetate/Formic acid/Acetic acid/Water (100:11:11:27)	Natural products- Poly ethyleneglycol reagent	UV 366 nm	orange/yellow/green/blue
7	Glycosides	10 ml 50%methanol +10%lead acetate and extract by chloroform	Ethyl acetate/Methanol/Water (81:11:8)	Kedde reagent	Visible	pink/purple
8	Phenolic compounds	10 ml dichloromethane	Toluene / Ethyl acetate (93: 7)	Ferric chloride reagent	Visible	Blue-black/ Green-black
9	Saponins	10 ml methanol and extract by 1 ml water + 3ml butanol	Chloroform/Methanol/Water (64:50:10)	Vanillin-Sulfuric acid reagent	Visible	blue
10	Scopoletin	5 ml methanol+ 5 ml dichloromethane	Ethyl acetate/Methanol/Water (100:6:4)	-	UV 366 nm	light blue
11	Sugars	10 ml water	Acetonitrile/Water (4:1)	10 % Sulfuric acid	Heat 100°C Visible	gray

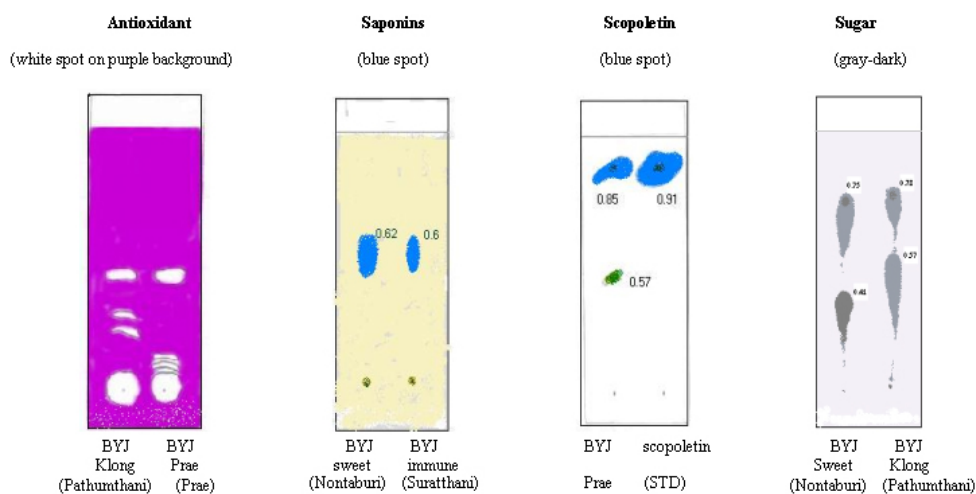


Figure 2. The TLC chromatograms show the characteristic of organic substances of the BYJ extract products: anti-oxidant, saponins, scopoletin and sugar.

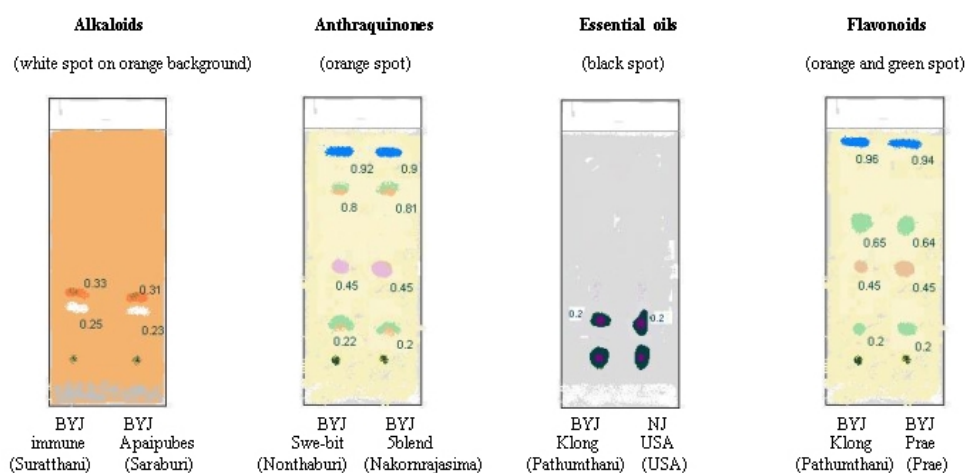


Figure 3. The TLC chromatograms show the characteristic of organic substances of the BYJ extract products: alkaloids, anthraquinones, essential oils and Flavonoids.

of Thai Yor was higher than that of Noni juice (NJ) from the U.S. (Figure 1).

The characteristics of the organic substances of the BYJ extract are shown on the TLC chromatograms (Figure 2 and 3) and Table 2. Scopoletin substance, of which its high content was found in all samples, was used as the reference standard of the TLC method. Anti-oxidant, sugars and saponins in BYJ were found to be high (Fig-

ure 2). Essential oils were found to be moderately high, while anthraquinones, alkaloids and flavonoids were low (Figure 3).

According to Solomon (2000), it is best to take Noni for five days a week and rest for two days in order to allow the body system to accept and absorb Noni better. However, people with auto-immune deficiencies should take Noni juice continuously without a brake. The dosage of Noni

Table 2. Results of TLC in bio-active Yor juice (BYJ) made of Yor material from provinces in Thailand and NJ from USA.

No.	Test	BYJ-Klong (Pathumthani)	BYJ-sweet (Nontaburi)	BYJ-Prae (Prae)	BYJ-immun (Suratthani)	YJ-apaipubes (Saraburi)	BYJ-Swe-bit (Nonthaburi)	BYJ-5Blend (Nakornrajasima)	NJ-USA (USA)
1	Alkaloids	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
2	Antraquinones	✓	✓	✓	×	✓	✓	✓	✓
3	Antioxidants	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
4	Coumarins	×	×	×	×	×	×	×	×
5	Essential oils	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
6	Flavonoids	✓	✓	✓	✓	✓	✓	✓	✓
7	Glycosides	×	×	×	×	×	×	×	×
8	Phenolic compounds	×	×	×	×	×	×	×	×
9	Saponins	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
10	Scopoletin	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
11	Sugars	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓

Found (✓ little ✓✓ medium ✓✓✓ high) × not found

Table 3. Nutritional value of Bio active Yor Juice (BYJ) extract and commercial Noni juice

Nutrition	100 mlBYJ-extract (30 ml/serving)	100 ml NJ (30 ml/serving)
Fat, g	1.66 (0.5)	0.93 (0.28)
Protein, g	2.10 (0.63)	1.17 (0.35)
Carbohydrate, g	51.23 (15.37)	25.93 (7.78)
Fiber, g	0.00 (0.00)	0.00 (0.0)
Calories, Kcal	228.27 (68.48)	16.67 (35.01)

juice as a supplemented food is approximately 1 to 2 table spoons twice a day depending on one's particular health condition and severity. It should be taken at least 1/2 hour before meal in order for the essential elements to be more efficiently processed in the intestines. One should stop taking Noni juice if some indications of problem occur.

The calories and mineral contents of BYJ extract and recommended daily intakes (RDI) are shown in Table 4. Table 5 shows the results of the analysis of BYJ conducted by the Thai Ministry of Public Health, which, among other things, indicate that BYJ is free from microorganism such as *E. coli*, yeast and mold, coliforms, Salmonella, *C. perfringens*, *S. aureus*, *B. cereus*. The BYJ extract is considered to be a miracle juice product of high nutraceutical and functional food value by the people in South-Pacific and around South East Asia. The BYJ extract or Noni juice is recommended by 50 medical doctors in USA and Hawaii to help relieve their patients from about 23 different conditions, such as allergy, anti-aging, arthritis, cancer, diabetes (type I and II), digestion, muscle pain, high blood pressure etc. and to increase the feelings of well being (Solomon, 2000).

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Table 4. Nutritional value per serving (30 ml) of BYJ and NJ calculated in percentage of Thai RDI.

Nutrition	Thai-RDI	BYJ (Thai RDI)	NJ (Thai RDI)
Fat-soluble vitamins			
Vitamin A	800 µg RE*(2,664 IU)	0.222 µg (0.028%)	X
Water-soluble vitamins			
Vitamin B ₁ (Thiamin)	1.5 mg	13.69 m (912.67%)	5.34 mg (256.00%)
Vitamin B ₂ (Riboflavin)	1.7 mg	12.77 mg (751.18%)	6.13 mg (360.59%)
Niacin	20 mg	17.54 mg (87.70%)	12.95 mg (64.75%)
Vitamin B ₁₂	2 µg	11.56 mg (578.00%)	7.95 mg (397.50%)
Vitamin C	60 mg	29.29 mg (48.82%)	19.34 mg (32.23%)
Electrolytes & Minerals			
Sodium	2,400 mg	2.45 mg (0.102%)	X
Potassium	3,500 mg	7.93 mg (0.227%)	X
Calcium	800 mg	7.03 mg (0.88%)	X
Iron	15 mg	0.8 mg (5.33%)	X
Trace minerals			
Selenium	70 µg	2.76 µg (3.94%)	X

Note *RE = Retinol equivalent; 1 RE = 1 mg retinal
 **α-TE = α-Tocopherol equivalent; 1α-TE = 1 mg D-α-tocopherol
 X = not available
 RDI = Recommended daily intakes

Table 5. The analysis results of Bio-active Yor Juice (BYJ) in the close container.

Parameters No. 214*	
Sample characteristic: brown solution	
Synthetic color, mg/kg	= not detected
Sodium benzoate, mg/100 g	= not detected
Benzoic acid, mg/100 g	= not detected
Lead (Pb), mg/kg	< 0.10
<i>Escherichia coli</i> , (/1 g)	= not detected
Yeast & mould count, (CFU/1 g)	= not detected
Coliforms, (MPN/100 ml)	= not detected
<i>Salmonella</i> , (/25 g)	= not detected
<i>Costridium perfringens</i> , (/1 g)	= not detected
<i>Staphylococcus aureus</i> , (/1 g)	= not detected
<i>Bacillus cereus</i> , (/0.1 g)	= not detected
Calcium (Ca), mg/kg	= 234.47
Iron (Fe), mg/kg	= 4.07
Vitamin A (all trans-retinol), µg/100 ml	= 0.74
Vitamin B ₁ , mg/100 g	= 36.03
Vitamin B ₂ , mg/100 g	= 81.36
Vitamin C, (as L-ascorbic acid), mg/100 g	= 78.54
Niacin, mg/100 g	= 50.77

* The requirement analysis parameter No.214 for the close container products of the Ministry of Public Health, Thailand

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