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Phytochemistry, nutrient, mineral, and antioxidant activities of two species *Morinda* L. grown in three provinces in Vietnam

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Abstract— The paper focused on the composition of the phytochemistry, the nutrient, and the mineral, and antioxidant activities of *Morinda* L. grown in three provinces (the central and the south area) in Vietnam. Phytochemistry (flavonoid, triterpenoid, alkaloid, and tannins), nutrient (protein, fat, carbohydrate, and fiber), minerals (Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, Cu^{2+}), and antioxidant activities (total, reducing power, and DPPH free radical scavenging) of species *Morinda* L. grown in Binh Phuoc, Khanh Hoa, and Ca Mau province in Vietnam were evaluated and compared. The results showed that the difference in the nutrient, the minerals, and antioxidant activities between species *Morinda* L. grown in three provinces occurred ($p<0.05$). The different species and habitats caused different nutrient, minerals, and antioxidant activities. Different phytochemistry appeared in all Noni samples.Antioxidant activities of species *Morinda tomentosa* grown in Khanh Hoa province was higher than *Morinda citrifolia* in Binh Phuoc and Ca Mau province. Minerals content decreased in order Binh Phuoc, Khanh Hoa, and Ca Mau. Nutrient content basing on protein content, *Morinda*L. grown Ca Mau province was evaluated higher than Binh Phuoc and Khanh Hoa.

Keywords— *Morinda*, phytochemistry, nutrient, mineral, antioxidant.

Introduction

Medicine plants are known as a bioactive-rich resource containing the diverse of phytochemical compositions useful for human health, such as flavonoids, triterpenoid, alkaloid, tannins, and polyphenol. [1] Phytochemical compositions possess numerous bioactive diverse (antioxidants, antibacterial, anti-cancer, anti-tumour), play an essential role in disease prevention, [2] and reduced free radicals causing many degenerative diseases in human, for example, cancer, cardiovascular diseases, and diabetes.[2,3] Phytochemistry compositions in a dietary antioxidants role protect against free radicals in the human body. The sources of antioxidants in medicine plants are useful in the reduce and the neutralize of oxidant sources in the human body.[4] The medicine plants also contained essential nutritional constituents well for a balanced diet, and they link to health-related phytochemicals.[5,6]

Noni (*Morinda* L.) is a medicinal plant commonly found in the world and found in nature and farms in Vietnam. Adansonia et al. noticed 39 species *Morinda*.[7]Species *Morinda* sp. possess value bioactive, for example, antioxidant, antibacterial,[8]anti-osteoporosis, Alzheimer disease treatment support, anti-rheumatoid, anti-radiation, anti-fatigue, cardiovascular protection, immune-regulatory, and anti-inflammatory.[9]Species *Morinda tinctoria* is detected as the bioactive natural products useful in the new pharmaceuticals and possessed strong antibacterial.[8]*Morinda citrifolia* contains more than 200 bioactive phytochemical substances consisting of polyphenol,[10]triterpenoids, anthraquinones, lactones, carotenoids, ketones, flavonoids, glycosides, iridoids, lactones, and lignans with the high nutritional value.[11]However, the phytochemistry compositions, nutrition components, minerals, and antioxidant activity of *Morinda* L. grown in Vietnam did not notice. An understanding of phytochemistry, the nutrient, the mineral compositions, and antioxidant activity of *Morinda* will support the increase of the exploitation and the use of them in other fields, for example, functional foods, and pharmaceuticals. There are ten species *Morinda* L. found in Vietnam such as *Morinda officinalis, Morinda longissima, Morinda cochinchinensis, Morinda villosa, Morinda tomentosa, Morinda citrifolia, Morinda parvifolia, Morinda persicaefolia, Morinda umbellata,* and *Morinda longifolia*.[12] All species are useful in traditional medicine for improving health, but the notices on phytochemistry, nutrient, mineral, and antioxidant activity of species *Morinda* L. did not present.

Thus, the phytochemistry composition (triterpenoids, flavonoids, alkaloids, and tannins), nutrition component (protein, fat, carbohydrate, and fiber), minerals content (Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, and Cu^{2+}), and antioxidant activity (total antioxidant activity, reducing power, and DPPH free scavenging activity) of two species Morinda L. (*Morinda citrifolia, Morinda tomentosa*) growth in Khanh Hoa, Binh Phuoc, Ca Mau province, Vietnam presented in the study.

Material and methods

2.1. Sample preparation

Morinda L. (*Morinda citrifolia* grown in Binh Phuoc and Ca Mau province, *Morinda tomentosa* found in Khanh Hoa province) was harvested, classified, and cleaned under running water tap for removing impurities. *Morinda* L. was then thinly sliced, dried at 50^{o}C and 6 hours, and ground. The *Morinda* L. powder was put in a vacuumed aluminium bag and stored at -18^{o}C for further studies.

2.2. Extract preparation

Morinda L. powder was soaked in the supersonic assisted tank (37 kHz of frequency, 800W of supersonic power) with the 96% ethanol-to-powder ratio of 30/1 (v/w) at 50^{o}C for 60 minutes, and collected the filtration through the paper Whatman No 4 for phytochemistry quantification.

2.3. Methods

Qualitative of phytochemistry composition

Qualitative of flavonoids, alkaloids, triterpenoids, and tannins were according tothe method of Jamuna et al. (2014).[13]

Quantification of nutrition components

Protein content

Protein content quantification based on the AOAC method (920.103) with the factor 6.25.[14]

Fat content

Crude fat determination was according to the AOAC method (2003.05).[15]

Carbohydrate content

Carbohydrate content quantificationwas with the glucose standard and using the wavelength of 490nm for the absorbance measurement.[16]

*Fiber conten*t

Fiber content quantification based on the AOAC method 995.29.[17]

Evaluation of antioxidant activity

Total antioxidant activity

Determination of total antioxidant activity used the reaction reagent (0.6M H_2SO_4, 1 ml of 28mM sodium phosphate, and 1 ml of 4mM ammonium molybdate).[18] The absorbance measurement of the extract was at 695nm using the ascorbic acid standard.

Reducing power activity

Reducing power activity was determined to base on the transfer Fe^{3+} to Fe^{2+}, measured the absorbance at 655nm,and using the $FeSO_4$standard.[19]

DPPH free radical scavenging activity

DPPH free radical scavenging activity was determined to base on the description of Dang et al. (2016),[20] for example, the assay sample (0.5 ml of extract, 3 ml of absolute ethanol, and 0.3 ml of 0.5mM DPPH in ethanol), the blank sample (3.3ml of absolute ethanol and 0.5 ml of extract), and the control sample (3.5 ml of absolute ethanol and 0.3 ml of 0.5mM DPPH in ethanol). The absorbance of all samples was measured at 517nm and calculated according to the following equation.

$$AA\% = 100 - \left[\frac{(Abs_{sample} - Abs_{blank})x100}{Abs_{control}}\right]$$

Where in:

AA%: DPPH free radical scavenging activity, (%);

Abs_{sample}, Abs_{blank}, and $Abs_{control}$ was the absorbance of the assay, blank, and control sample, respectively.

Quantification of minerals content

Minerals content quantification based on the**AOAC (2005) method,[21] for example, magnesium (920.09),calcium (910.01), iron (937.03), sodium (956.01), copper (975.03), and zinconium (975.03).**

Data analysis

All experiments were triplicated (n=3), analysed descriptive statistics, and ANOVA using the software of MS. Excel 2013.The unnormal values removement based on the Duncan method.

Results and discussion

Phytochemistry composition

All species *Morinda* L. such as *Morinda tomentosa* and *Morinda citrifolia* grown in Khanh Hoa, Binh Phuoc, and Ca Mau province contained flavonoid, triterpenoid, alkaloid, and tannins. The present of phytochemistry composition in other species *Morinda* L. was different and depended on habitats. Flavonoid content was the highest in species *Morinda tomentosa*, following *Morinda citrifolia* grown in Binh Phuoc province, and Ca Mau province, in order. Triterpenoid content existed in species *Morinda citrifolia* in Ca Mau province was the highest, compared to species *Morinda* L. in Khanh Hoa and Binh Phuoc province. Triterpenoid present in species *Morinda* L. grown in Khanh Hoa province was equal to Binh Phuoc province, and the thing was similar to alkaloid present. Tannins present in species *Morinda tomentosa* and *Morinda citrifolia* corresponded each other. Species *Morindatomentosa* in Khanh Hoa province possessed phytochemistry compositions decreasing in the following order: flavonoid, alkaloid, triterpenoid, and tannins.*Morinda citrifolia* in Ca Mau province contained the highest triterpenoid content, compared to the flavonoid, alkaloid, and tannins. Flavonoid content corresponded to alkaloid content, triterpenoid content presented similar to tannins, in *Morinda citrifolia* grown in Binh Phuoc province. The phytochemistry compositions were noticed in numerous previous studies and mainly presented on *Morinda citrifolia* L., except for *Morinda citrifolia*in Vietnam. [22]The phytochemistry compositions of two species *Morinda* L. (*Morinda tomentosa, Morinda citrifolia*) grown in three provinces in Vietnam was noticed in the first time in the current study.

Tab 1: Phytochemistry compositions of species *Morinda* L. grown in three provinces in Vietnam

Phytochemistry	**Species *Morinda* L.**		
	Morinda tomentosa	***Morinda citrifolia***	
	Khanh Hoa	**Binh Phuoc**	**Ca Mau**
Flavonoid	+++	++	+
Triterpenoid	+	+	++
Alkaloid	++	++	+
Tannins	+	+	+

Note: "+" presented; "++" presented much; "+++" presented very much

Nutrient composition

The results showed that the content of protein, fat, carbohydrate, and fiber varied from 2.72 ± 0.11 to 3.46 ± 0.15 (%), 7.53 ± 23.34 to 9.72 ± 0.26 (%), 23.81 ± 0.69 to 25.17 ± 0.58 (%), 48.55 ± 1.89 to 49.11 ± 2.06 (%), respectively. The content of protein and fat decreased in the following order: Binh Phuoc, Ca Mau, and Khanh Hoa province. Protein content was significantly different between *Morinda citrifolia*and *Morinda tomentosa* and depended on inhabits ($p<0.05$), similar to fat content ($p<0.05$). Protein content in *Morinda tomentosa* and *Morinda citrifolia*in Ca Mau province was 0.79 and 0.86 times of *Morinda citrifolia*in Binh Phuoc province. Fat content got the highest value in *Morinda citrifolia*in Binh Phuoc province and 1.29 and 1.23 times of *Morinda* L. in Khanh Hoa and Ca Mau province, respectively. The difference in carbohydrate content occurred between *Morinda tomentosa* in Khanh Hoa province and *Morinda citrifolia* in Binh Phuoc province ($p<0.05$). Carbohydrate content in *Morinda* L.in Khanh Hoa province and Ca Mau province was not different significantly, found in *Morinda* L. inBinh Phuoc and Ca Mau province. Carbohydrate content in *Morinda* L. inBinh Phuoc was lower than Khanh Hoa and Ca Mau province. The fiber content in species *Morinda* L. grown in Khanh Hoa, Binh Phuoc, and Ca Mau province was not a significant difference ($p>0.05$). The thing showed that fiber content in species *Morinda* L. in three provinces in Vietnam did not depend on species and growth area. The nutrient compositions in species *Morinda* L. in the current study were different significantly, compared to the previous studies on *Morinda* L. [23,24,25]

Tab 2: Nutrient compositions of species *Morinda* L. grown in three provinces in Vietnam

Nutrient	Species *Morinda* L.		
	Morinda tomentosa	***Morinda citrifolia***	
	Khanh Hoa	**Binh Phuoc**	**Ca Mau**
Protein (%, DW)	2.72 ± 0.11^{a}	3.46 ± 0.15^{b}	2.98 ± 0.12^{c}
Fat (%, DW)	7.53 ± 0.34^{a}	9.72 ± 0.26^{b}	8.64 ± 0.18^{c}
Carbohydrate (%, DW)	25.17 ± 0.58^{a}	23.81 ± 0.69^{b}	24.03 ± 0.84^{ab}
Fiber (%, DW)	49.26 ± 1.82^{a}	48.55 ± 1.89^{a}	49.11 ± 2.06^{a}

Minerals composition

Species *Morinda* L. grown in Binh Phuoc province possessed minerals (Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, and Cu^{2+}) higher than *Morinda tomentosa* in Khanh Hoa province and *Morinda citrifolia*in Ca Mau province. The growth area of *Morinda* L. did not affect the content of Mg^{2+} and Na^{+} ($p>0.05$) that varied from 4924.89 ± 156.73 to 5,013.77 ± 142.67 (ppm) and 4,901.05 ± 172.91 to 4,952.75 ± 170.28 (ppm), respectively. The content of Fe^{3+} and Cu^{2+} in species *Morinda* L. was affected by the inhabits ($p<0.05$). The content of Fe^{3+} and Cu^{2+} varied from 213.59 ± 6.93 to 275.31 ± 7.17 (ppm) and 3.21 ± 0.07 to 4.48 ± 0.16 (ppm), respectively. The content of Fe^{3+} and Cu^{2+} decreased in the following order: Binh Phuoc, Ca Mau, and Khanh Hoa province. The significant difference in Ca^{2+} content occurred between *Morinda tomentosa* in Khanh Hoa province and *Morinda citrifolia* in Binh Phuoc province ($p<0.05$). The non-significant difference occurred between *Morinda* L. in Khanh Hoa and Ca Mau province, Binh Phuoc and Ca Mau province ($p>0.05$) and the thing was similar to Zn^{2+}. The content of Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, and Cu^{2+} in *Morinda citrifolia* in Binh Phuoc province was 106, 102.67, 128.89, 107.73, 103.03, and 174.14% in comparison to *Morinda*

tomentosa in Khanh Hoa province, respectively. The content of Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, and Cu^{2+} in *Morinda tomentosa* in Khanh Hoa provincewas 0.97, 1.02, 0.86, 0.96, 1.01, and 0.72 times, compared to *Morinda citrifolia* in Ca Mau province, respectively. Minerals (Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, and Cu^{2+}) existing in species *Morinda* L. are useful for human health. Therefore, minerals in Noni fruit have potential in producing functional foods for human health and noni fruit inBinh Phuoc province is the best choice, compared to Khanh Hoa and Ca Mau province. Mineral compositions in species *Morinda tomentosa* and *Morinda citrifolia* in the current study was different in comparison to the previous studies on mineral in *Morinda.*[26] The difference depends on weather and climate where *Morinda* L. grown.

Tab 3: Minerals compositions of species *Morinda* L. grown in three provinces in Vietnam

Minerals	**Species *Morinda* L.**		
	Morinda tomentosa	***Morinda citrifolia***	
	Khanh Hoa	**Binh Phuoc**	**Ca Mau**
Ca^{2+} (ppm)	$5{,}218.62 \pm 141.29^{a}$	$5{,}532.19 \pm 135.74^{b}$	$5{,}368.17 \pm 128.36^{ab}$
Mg^{2+} (ppm)	$5{,}013.77 \pm 142.67^{a}$	$5{,}147.63 \pm 148.22^{a}$	4924.89 ± 156.73^{a}
Fe^{3+} (ppm)	213.59 ± 6.93^{a}	275.31 ± 7.17^{b}	249.88 ± 6.93^{c}
Zn^{2+} (ppm)	176.48 ± 5.19^{a}	190.12 ± 8.53^{b}	184.11 ± 6.22^{ab}
Na^{+} (ppm)	$4{,}952.75 \pm 170.28^{a}$	$5{,}103.11 \pm 193.74^{a}$	$4{,}901.05 \pm 172.91^{a}$
Cu^{2+} (ppm)	3.21 ± 0.07^{a}	5.59 ± 0.14^{b}	4.48 ± 0.16^{c}

Note: Small letters such as a, b, and c presented significant difference according to the row

Antioxidant activities

All species *Morinda* L. (*Morinda tomentosa* and *Morinda citrifolia)* grown in Khanh Hoa, Binh Phuoc, and Ca Mau province possessed different antioxidant activities such as total antioxidant activity, reducing power activity, and DPPH free radical scavenging activity. The difference in total antioxidant activity occurred between species *Morinda* L. and the difference presented between other provinces ($p<0.05$). Total antioxidant activity of species *Morinda* L. varied from 35.76 ± 0.87 to 39.84 ± 0.92 (mg ascorbic acid equivalent/g DW), corresponding to *Morinda citrifolia*in Binh Phuoc and Ca Mau province. Reducing power activity of species *Morinda tomentosa* in Khanh Hoa province and species *Morinda citrifolia*in Ca Mau province was not different significantly ($p>0.05$). Reducing power activity of *Morinda citrifolia* in Binh Phuoc province got the highest value (28.51 ± 0.79 mg $FeSO_4$ equivalent/g DW) and significant difference, compared to Khanh Hoa and Ca Mau province ($p<0.05$) (Table 4). Reducing power activity of *Morinda tomentosa* in Khanh Hoa province was 92.39% and 102.41% in comparison to *Morinda citrifolia* in Binh Phuoc and Ca Mau province, respectively. DPPH free radical scavenging activity did not depend on species and habitats ($p>0.05$) and was from 77.58 ± 1.69 to 79.29 ± 1.85 (%), corresponding to *Morinda citrifolia*in Binh Phuoc province and *Morinda tomentosa* in Khanh Hoa province. Therefore, species *Morinda tomentosa* in Khanh Hoa province has a potency in antioxidant activities harvest servicing in functional food and pharmaceuticals. Ethanol extract from *Morinda citrifolia*in Binh Phuoc and Ca Mau province has potent in the transfer Fe^{3+} to Fe^{2+} and Mo^{6+} to Mo^{5+}, respectively. DPPH free radical scavenging in the current study was similar to the notice of Deepti *et al.* (2015) on *Morinda tinctoria*[27] and higher than the

notice of Malsha et al. (2019). [28]

Tab4: Antioxidant activities of species *Morinda* L. grown in three provinces in Vietnam

Antioxidant activity	Species *Morinda* L.		
	Morinda tomentosa	*Morinda citrifolia*	
	Khanh Hoa	Binh Phuoc	Ca Mau
Total antioxidant activity (mg ascorbic acid equivalent/g DW)	38.55 ± 0.96	35.76 ± 0.87	39.84 ± 0.92
Reducing power activity (mg $FeSO_4$ equivalent/g DW)	26.34 ± 0.82	28.51 ± 0.79	25.72 ± 0.63
DPPH free radical scavenging activity (%)	79.29 ± 1.85	77.58 ± 1.69	78.23 ± 1.69

Conclusion

Phytochemistry (alkaloids, flavonoids, triterpenoids, and tannins), nutrient (protein, fat, carbohydrate, and fiber), minerals (Ca^{2+}, Mg^{2+}, Fe^{3+}, Zn^{2+}, Na^{+}, and Cu^{2+}) and antioxidant activities of two species *Morinda* L. (*Morinda tomentosa,* and *Morinda citrifolia*) grown in three other provinces (Khanh Hoa, Binh Phuoc, and Ca Mau), Vietnam depended on species and growth area. Species *Morinda tomentosa*in Khanh Hoa had a potency on antioxidant activity and phytochemistry compositions, compared to *Morinda citrifolia*in Binh Phuoc and Ca Mau province. Species *Morinda citrifolia*in Binh Phuoc possessed a potency on the content of the nutrient and the minerals in comparison to Khanh Hoa and Ca Mau province. Species *Morinda* L. grown in Khanh Hoa and Binh Phuoc province are useful for the functional food and the pharmacy more than species *Morinda citrifolia* in Ca Mau province.

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