International Journal of Advanced Science and Technology
Vol. 29, No. 8s, (2020), pp. 2752-2759

Health Care and Economic Perspectives of Hydroponic Vegetables in Ongkharak Nakhon Nayok Thailand

Vijaya Bhaskara Reddy. M[1*], Somboon Boonyakiat[2], Sourabh Singha Roy[3], Alfledo C. Espejo[4], Phattaradanai Dongsungnoen[5], and Worapote Siriwunsakul[6]

[1]Faculty of Public Health, ST Theresa International College, 1 Moo 6, Rang sit, Nakhonnayok Road, Klong 14, Bungsan, Ongkharak, Nakhonnayok- 26120, Thailand. Phone No: +66-994984030, Email: vijaya@stic.ac.th
[2]Faculty of Nursing Science, Kasem Bundit University, Thailand.
[3,4,5,6]Faculty of Business Administration, ST Theresa International College, 1 Moo 6, Rang sit, Nakhonnayok Road, Klong 14, Bungsan, Ongkharak, Nakhonnayok- 26120, Thailand

Abstract

Worldwide hydroponic cropping system is extending, it offers new alternatives and opportunities for growers. Consumers, to have high quality vegetables with enhanced bioactive compounds, nutritionally rich and without pesticides. Most of the consumers worried about the safety issues and expressed their feelings on safety. Primary data was collected from Ongkharak, Thailand by the authors with the help of Thai-native speaker through questionnaire and personal interviews with the respondents. Farmers often claims that hydroponics always have high productivity and yields without the constraints of weather and weather conditions. Globally, Governments are encouraging them to empower healthy life style, community economy and socio-economic cooperation towards community sustainable development. Result were showed the intentions towards purchasing hydroponics in pregnant females. Women with maturity are more interested in hydroponic vegetables purchasing when compared with the youngsters. Which means the consumers are ready to buy good, fresh, nutritious hydroponic vegetables than the normal vegetables irrespective of availability and price. Results showed intentions towards purchasing hydroponics depends on nutritional values, freshness, pesticide free and health concerns are the most influencing factors in pregnant women.

***Key words**: Health care, Economic perspective, Hydroponic vegetables, and women.*

1. Introduction

Hydroponic systems for vegetable production, these days are essential to increase production and maximize yields. Although, technical issues related to production are well explored and discussed, little is known about the impact of hydroponic methods on the nutritional status of fresh vegetables and especially on their bioactive compounds. In fact, Europe is considered the largest market for hydroponics, with France, Netherlands and Spain being the top three producers, followed by the United States of America and Asia-Pacific. These systems are widespread worldwide, and according to a recent report [1], it forecasts global growth of 18.8% from 2017 to 2023, USD 490.50 million global hydroponic market by 2023. According to growers, hydroponic systems can help expand their capacity for sustained production in short period of time, require less space, and can be produced anywhere with a small place under controlled environment. Farmers often claims that hydroponics always have high productivity and yields without the constraints of weather and weather conditions. Moreover, hydroponics does not depend on seasonality and, therefore, their productivity is high and homogeneous throughout the year.

The hydroponic products are said to be superior because of highly controlled environment and allows for more homogeneous production without losing nutrients and water.

ISSN: 2005-4238 IJAST

Hydroponic productions are easier, lighter and clean, with no cultural activities such as ploughing, soil fertilization, weeding, and crop rotation. However, scientific evidence is often contradictory and various disadvantages have been reported to justify their rejection: high technical, initial costs, and plant physiological knowledge, efficient electrical systems and periodic work routines [2-6].

There is a strong need in the part of the Thai government to empower the socio-economic status through sustainable community development. There is a need to encourage community to make use their front or backyard soils to cultivate plants with highly economic. Globally, Governments are encouraging them to empower healthy life style, community economy and socio-economic cooperation towards community sustainable development.

2. Methodology

Primary data was collected from Ongkharak, Thailand by the authors with the help of Thai-native speaker through questionnaire and personal interviews with the respondents. To get reliable and accurate data, precautionary steps were taken, apart from that caution and care taken while collecting data. Prior to interview we took respondents consent (Consent letter/ Memo no. PH/2019/HE/20 Dt. 24/07/2019) and possible efforts to establish a friendly relationship with the study subjects so that the respondents do not feel hesitate to provide data and explained the objective of the research to each and every respondent.

A Quantitative study was executed by using survey questionnaire to collect data at Ongkharak market. Desired questionnaires were adapted and modified accordingly [7]. Data was tabulated. Responses of the questionnaire items were scored using a Likert scale and tabulated. In addition, data analysis was carried out by SPSS (V. 22).

3. Results and Discussion

Table 1. Demographic distribution of the respondents

Parameter	Frequency (%)
Marital status	
Single mother	29 (58)
Married	31 (62)
Educational qualifications	
Uneducated	3 (6)
Primary	12 (24)
Higher	20 (40)
Bachelors and above	15 (30)
Age	
16-20	4 (8)
21-25	26 (52)

26-30	16 (32)
31-35	4 (8)

Source of data: Survey

Table 1 explores the demographical distribution of respondents on hydroponic vegetable buying patterns. Respondents were married females (100%), living with partner (62%) and married divorced or single (58%). All respondents were Thai- community. 8 % of the subjects are young, 84 % of them are under the age group of 21 ± 30 years. Most of them are in their mid-twenties. 30% of respondents are educated with bachelor and above, higher (40%) primary (24%) and uneducated (6%) respectively. Result were showed the intentions towards purchasing hydroponics in pregnant females. Women with maturity are more interested in hydroponic vegetables purchasing when compared with the youngsters. Even though, married single mothers are also intended to buy hydroponics which shows their intention towards the healthcare.

Table 2. Distribution of respondents based on their interest to buy hydroponic vegetables at Ongkharak market.

Parameter	**SA (%)**	**A (%)**	**DA (%)**	**SD (%)**	**UND (%)**
Why you would like to buy hydroponic food					
Due to nutritional values	30 (60)	16 (32)	1 (2)	2 (4)	1 (2)
No pesticides used	40 (80)	8 (16)	1 (2)	0 (0)	1 (2)
Choose specific product based on the availability	33 (66)	10 (20)	2 (4)	0 (0)	5 (10)
I will compare hydroponics with normal products	26 (52)	10 (20)	4 (8)	6 (12)	4 (8)
Able to purchase directly from the farmer or manufacturer	32 (64)	10 (20)	4 (8)	0 (0)	4 (8)
Good for health	37 (74)	8 (16)	0 (0)	0 (0)	5 (10)
Hydroponics are fresher than normal vegetables	39 (78)	10 (20)	0 (0)	0 (0)	1 (2)
Due to health official's promotion	29 (58)	14 (28)	0 (0)	0 (0)	7 (14)
Because I am pregnant	33 (66)	12 (24)	0 (0)	0 (0)	5 (10)
Because of doctors advise	22 (44)	15 (30)	0 (0)	1 (2)	12 (24)
I have read about uses of hydroponics on newspaper, or online	31 (62)	11 (22)	0 (0)	0 (0)	8 (16)
Do you think prices are high	28 (56)	8 (16)	11 (22)	3 (6)	0 (0)

*SA= Strongly Agree, A= Agree, DA= Disagree, SD= Strongly Disagree, UND= Undecided

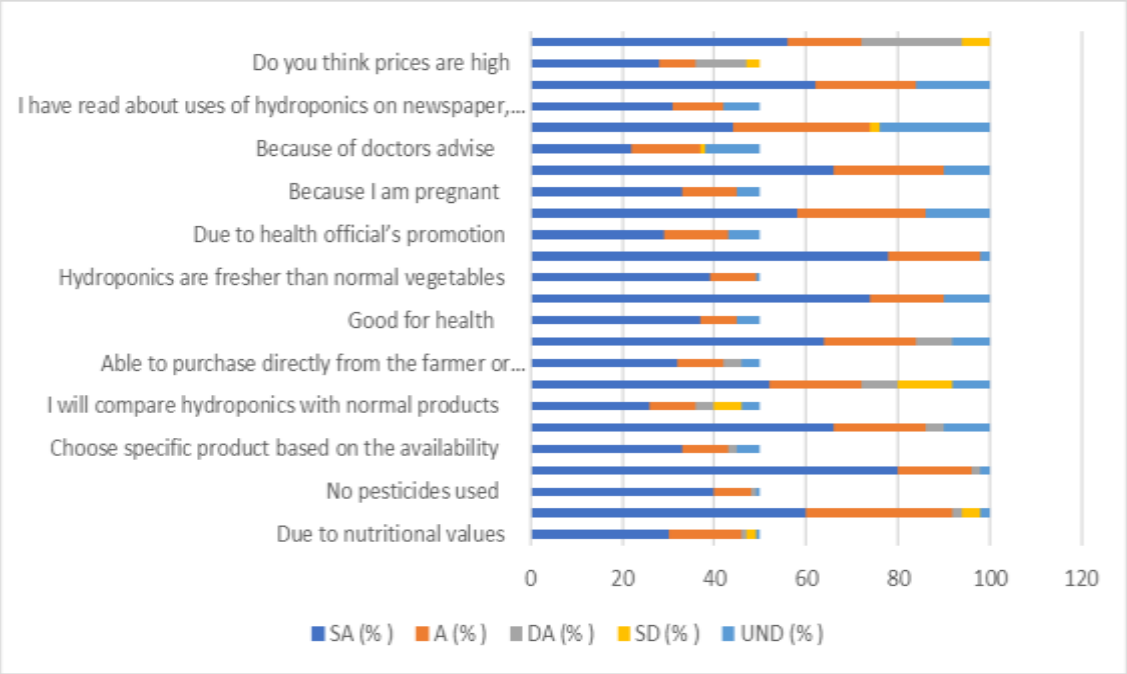

Figure: 1. Distribution of respondents based on their interest to buy hydroponic vegetables at Ongkharak market.

.

Table 2 elaborates the distribution of respondents based on their interest to buy hydroponic vegetables at Ongkharak market. Here specific respondent's interests are defined as product, brand, availability and quality for purchase. Respondents strongly agreed to their perceptions and behavioural attitudes such as: due to nutritional values (60%), no pesticides used (80%), Choose specific product based on the availability (66%), I will compare hydroponics with normal products (52%), Able to purchase directly from the farmer or manufacturer (64%), Good for health (74%), Hydroponics are fresher than normal vegetables (78%%), Due to health official's promotion (58%), Because I am pregnant (66%), Because of doctors advise (44%), and I have read about uses of hydroponics on newspaper, or online (62%) respectively. On the other hand, when we ask about prices most of the respondents were agreed such as strongly (56%), agreed (16%), disagreed (22), strongly disagree (6%) and few respondents were disagreed with some factors but comparatively negligible (Fig. 1) when compared with strongly agreed with respective factors. A comparative stacked bar chart shows the across categories changes over the categories. Which means the consumers are ready to buy good, fresh, nutritious hydroponic vegetables than the normal vegetables irrespective of prices and availability.

Table 3. The average score towards purchasing the hydroponics at Ongkharak.

Factor	**Score Range**	**Min-Max**	**$\bar{x}$**	**SD**	**Level**
Hydroponic Product	1 - 5	1.25 - 5	4. 95	0. 52	High
Promotion of hydroponics	1 - 5	1.25 - 5	4. 95	0. 52	High
Price hydroponics	1 - 5	2.20 - 5	4. 76	1.01	High
Place of availability	1 - 5	2.25 - 5	4. 79	0. 79	High

Table three elucidates the opinions towards influencing factors on product and promotion obtain highest priority with the average value of 4.95 and 0.52 of SD value.

Table: 4. Distribution of respondents based on their monthly income.

Baht		Frequency	%
Valid	< 10,000	14	28
	11,000- 20,000	21	42
	21,000- 30,000	5	10
	31,000- 40,000	10	20
	Total	50	100.0

Source: Field survey

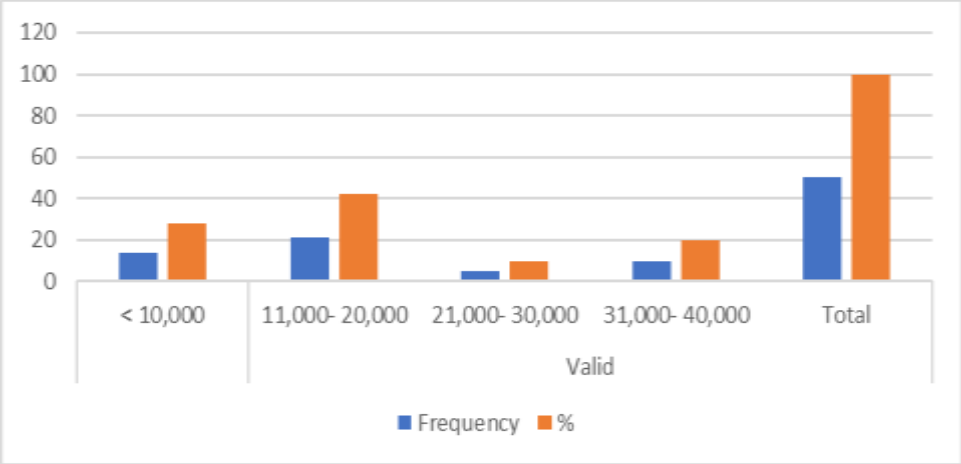

Figure: 2. Distribution of respondents based on their monthly income.

Table four demonstrates that the economic status of the respondents characterized by the monthly income. The study indicates that respondent's income was 11000 to 20,000 thousand (42%), less than 10,000 (28%), 31,000 to 40,000 (20%) and 21,000 to 30,000 (10%) respectively. the study indicates that the purchasing behaviors of respondents not significantly influenced with monthly income and socioeconomic status. Purchasing behavior depends on nutritional values, freshness, pesticide free and health concerns are the most influencing factors (figure.2).

Table 5. Comparative results between hydroponics and conventional soil-based production.

Crop	**Results**
Basil	The hydroponic cultivation improved the contents of vitamin C, vitamin E, lipoic acid, total phenols, and rosmarinic acid, as well as their antioxidant activities [8.]
Lettuce	Hydroponics offered 11 ± 1.7 times higher yields compared to conventionally produced, but also required 82 ± 11 times more energy [9].

Lettuce	Levels of alpha-tocopherol here were higher in hydroponics compared to conventional soil-based production [10].
Lettuce	The content of lutein, beta-carotene, violaxanthin, and neoxanthin were lower in hydroponics compared to the soil-based production, due to less exposure of hydroponics to sunlight and temperatures, which had significant impact on carotenogenesis decreasing their levels [11].
Lettuce	Hydroponics-grown lettuce had significantly lower concentration of microorganisms compared to other in-soil-grown lettuce [12].
Onion	Total flavonoids were similar between hydroponics and soil-based cultivation [13].
Red paprika	The content of carotenoids capsorubin and capsanthin was higher in hydroponics (4.50 and 46.74 mg/100 g dry weight, respectively) compared to convention soil culture (2.81 and 29.57 mg/100 g dry weight, respectively) [14].
Strawberry	Fruit yield per plant was 10% higher in hydroponic raspberries compared to soil grown raspberries [15].
Sweet potato	Carotenes, ascorbic acid, thiamine, oxalic and tannic acids, and chymotrypsin and trypsin inhibitors were higher under hydroponics [16].
Tomato	No significant differences between hydroponic and non-hydroponic tomatoes in the levels of lycopene content (averaging 36.15 and 36.25 μg/g, respectively) [16].
Tomato	Highly controlled conditions of electrical conductivity (EC) and salinity of water, pH, and nutrients provide optimum condition for enhancing the levels of sugars, Brix, pH, and organic acids, which are quality criteria of consumer acceptance toward tomato [17].

Study reveals that the hydroponics are mainly using due to their nutritional richness, pesticide free and grown under controlled conditions. Hence, these operations could increase the natural bioactive compounds, and enriches with nutrients (table 5).

In general, temperature and light saturation by leaf receptors enhances the rate of photosynthesis and carbohydrate production, which are beneficial for wide range of biochemical mechanisms such as biosynthesis of bioactive compounds and to increase their contents in hydroponic vegetables [18, 19]. Similar reports have been stated that increase levels of anthocyanin in berries, flavonoids, phenolic acids and anthocyanins under different temperatures, enhancement in the content of polyphenols and glucosinolates in *Eruca sativa*, *Eruca vesicaria,* and *Diplotaxis tenuifolia* [20]. Nutrient solutions with higher electrical conductivity (EC) enhances the lycopene contents in tomato [20, 21] similarly in rose in china [22].

Hence, growing plants in a highly controlled environment may be an effective alternative to enhance the synthesis of bioactive compounds. Therefore, a regular monitoring of nutrient solutions is required, in addition, to avoid diseases, infestations and regulation of disinfection systems are needed in order to achieve high quality and production.

4. Conclusion

Worldwide hydroponic cropping system is extending, it offers new alternatives and opportunities for growers. Consumers, to have high quality vegetables with enhanced bioactive compounds, nutritionally rich and without pesticides. Most of the consumers

worried about the safety issues and expressed their feelings on safety. We have given enough oral information while collecting the data. They are not confident enough to consume. Safety measures are not clear till date on consumption of hydroponics at study site. This research presented a general overview about the influencing factors on purchasing of hydroponics at Ongkharak, Nakhonnayok, Thailand.

Conflict of interest

No conflict of interest

References

1. Jensen MH, and Collins WL, "Hydroponic vegetable production", Horticultural Reviews, vol. 7, **(1985)**, pp. 483-558. DOI: 10.1002/9781118060735.ch10
2. Hughes AJ, "Experts: Hydroponic Growing Offers Advantages, But Won't Replace the Soil" **(2017)**, Available from: http://seedstock.com/2016/03/15/experts-hydroponic-growing- offers-advantages-but-wont-replace-soil/ [Accessed on 11 December 2019]
3. Sarah Wambua S, "Reasons Why Hydroponics Is Better Than Soil Farming" **(2017),** Available from: http://www.farmhydroponics.com/hydroponics/hydroponics-vs-soil [Accessed on November 20, 2019]
4. Okemwa E, "Effectiveness of aquaponic and hydroponic gardening to traditional gardening", International Journal of Scientific Research and Innovative Technology, vol. 2, **(2015)**, pp. 2313-3759. http://www.ijsrit.com/uploaded_all_files/3563230518_m3.pdf [Accessed on November 20, 2019]
5. Nguyen NT, McInturf SA, Mendoza-Czatl DG, "Hydroponics: A versatile system to study nutrient allocation and plant responses to nutrient availability and exposure to toxic elements", Journal of Visualized Experiments, vol. 113, **(2016)**, pp. 54317. DOI: 10.3791/54317
6. Lopes da Luz G, Petter Medeiros S, Manfron P, Borcioni E, Muller L, Dischkaln do Amaral A, Pereira Morais K. Consumo de energia elétrica e produção de alface hidropônica com três intervalos entre irrigações. Ciência Rural, vol. 38, **(2008)**, pp. 815-818. DOI:10.1590/S010384782008000800049
7. Reddy MVB, Buncha P, "Students Problem-Solving Difficulties and Implications in Physics: An Empirical Study on Influencing Factors", Journal of Education and Practice, vol 8, no. 14, **(2017)**, pp. 59-62
8. Sgherri C, Cecconami S, Pinzino C, Navari-Izzo F, Izzo R, "Levels of antioxidants and nutraceuticals in basil grown in hydroponics and soil", Food Chemistry, vol. 123, **(2010)**, pp. 416-422. DOI: 10.1016/j.foodchem.2010.04.058
9. Barbosa GL, Gadelha FDA, Kublik N, Proctor A, Reichelm L, Weissinger E, Wohlleb GM, Halden RU, "Comparison of land, water, and energy requirements of lettuce grown using hydroponic vs. conventional agricultural methods", International Journal of Environmental Research and Public Health, vol.12, **(2015)**, pp. 6879-6891. DOI: 10.3390/ijerph120606879
10. Buchanan DN, Omaye ST, "Comparative study of ascorbic acid and tocopherol concentrations in hydroponic- and soil-grown lettuces", Food and Nutrition Sciences, vol. 4, **(2013)**, 4:1047-1053. DOI: 10.4236/fns.2013.410136
11. Kimura M, Rodriguez-Amaya DB, "Carotenoid composition of hydroponic leafy vegetables" Journal of Agricultural and Food Chemistry, vol. 51, **(2003)**, pp. 2603-2607. DOI: 10.1021/jf020539b

12. Sirsat SA, Neal JA, "Microbial profile of soil-free versus in-soil grown lettuce and intervention methodologies to combat pathogen surrogates and spoilage microorganisms on lettuce" Food, vol. 2, **(2013)**, pp. 488-498. DOI: 10.3390/foods2040488
13. Thompson L, Morris J, Peffley E, Green C, Paré P, Tissue D, Jasoni R, Hutson J, Wehner B, Kane C, "Flavonol content and composition of spring onions grown hydroponically or in potting soil" Journal of Food Composition and Analysis, vol. 18, **(2005)**, pp. 635-645. DOI: 10.1016/j.jfca.2004.06.009
14. Kim J-S, An CG, Park J-S, Lim YP, Kim S, "Carotenoid profiling from 27 types of paprika (Capsicum annuum L.) with different colors, shapes, and cultivation methods" Food Chemistry, vol. 201, **(2016)**, pp. 64-71. DOI: 10.1016/j.foodchem.2016.01.041
15. Treftz C, Omaye ST, "Nutrient analysis of soil and soilless strawberries and raspberries grown in a greenhouse" Food and Nutrition Sciences, vol. 6, **(2015)**, pp. 805-815. DOI: 10.4236/fns.2015.69084
16. Ajlouni S, Kremer S, Masih L, "Lycopene content in hydroponic and non-hydroponic tomatoes during postharvest storage" Food Australia, vol. 53, **(2001)**, pp. 195-196. https://www.researchgate.net/profile/Said:Ajlouni/publication/259198470_Lycopene_content_in_hydroponic_and_non-hydroponic_tomatoes_during_postharvest_storage/links/53d9cca90cf2631430c7dc55.pdf (Accessed on January27, 2020)
17. DeBoer B, "Tasty Tomatoes: Improving Flavor and Quality in Hydroponically Grown Tomatoes" (**2016**). Available from: https://www.maximumyield.com/tasty-tomatoes-improving-flavor-and-quality-in-hydroponically-grown-tomatoes/2/1073 (Accessed on January26, 2020)
18. Greer DH, Weston C, "Heat stress affects flowering, berry growth, sugar accumulation and photosynthesis of *Vitis vinifera* cv. *Semillon* grapevines grown in a controlled environment" Functional Plant Biology, vol. 37, **(2010)**, pp. 206-214. DOI: 10.1071/FP09209
19. Shashirekha MN, Mallikarjuna SE, Rajarathnam S, "Status of bioactive compounds in foods, with focus on fruits and vegetables" Critical Reviews in Food Science and Nutrition vol. 55, **(2015)**, pp. 1324-1339. DOI: 10.1080/10408398.2012.692736
20. Almazan AM, Begum F, Jonson C, "Nutritional quality of sweet potato greens from greenhouse plants" Journal of Food Composition and Analysis, vol. 10, **(1997)**, pp. 246-253. DOI: 10.1006/jfca.1997.0538
21. Kubota C, Thomson CA, Wu M, Javanmardi J, "Controlled environments for production of value-added food crops with high phytochemical concentrations: Lycopene in tomato as an example" Hort Science, vol. 41, **(2006)**, pp. 522-525 http://hortsci.ashspublications.org/content/41/3/522.abstract
22. Ren J, Guo S-S, Xin X-L, Chen L, "Changes in volatile constituents and phenols from *Gynura bicolor* DC grown in elevated CO2 and LED lighting" Science and Horticulture, vol. 175, **(2014)**, pp. 243-250. DOI: 10.1016/j.scienta.2014.06.023