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# Comparison of Nutritional Content of Spinach (*Amaranthus gangeticus L.*) Cultivated Hydroponically and Non-Hydroponically

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**Abstract.** The objectives of this study to determine the comparison of the nutritional content of spinach cultivated hydroponically and non-hydroponically, especially the content of Vitamin C. This research was conducted at the Wire House Biology Laboratory of Padang State University in May - July 2020. This research is a descriptive study. The analysis was carried out Spinach Nutrition. Hydroponic spinach samples were obtained from the Hydroponic Community of West Sumatra in Alai Padang, while the non-hydroponic samples were purchased at Pasar Raya Padang, the analysis of vitamin C content was carried out by the Spectrophotometric Method. From the research that has been done, it is found that the average content of hydroponic spinach vitamin C is 1.45 ppm and non-hydroponic 1.60 ppm. The conclusion of the research is that the content of Vitamin C in hydroponic cultivated spinach is lower than that of spinach cultivated non-hydroponically.



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## 1. Introduction

Vitamins are organic compounds that cannot be produced directly in the body. The role of vitamins is as a regulator and builder along with other nutrients through the formation of enzymes, antibodies, and hormones. vitamins have a special role that cannot be replaced by other substances [15]. Many vitamins are contained in green vegetables. One of the high nutrition vegetables is spinach. Spinach (*Amaranthus sp*) is a vegetable plant that has many benefits for the body because of its high nutritional content. Various vitamins are contained in spinach such as vitamins A, B, C and E, besides that spinach also contains micro elements such as iron, minerals and other micro elements. Vitamin C is a water-soluble vitamin that functions to form body tissues, form collagen, strengthen blood vessels, help absorb iron (Fe), and antioxidants [19]. Spinach can be cultivated hydroponically and non-hydroponically.

Spinach also contains antioxidants, namely beta-carotene. This beta-carotene compound has the same function or benefit as antisianin, as an antioxidant compound that is very important for the body. The content of vitamin A and vitamin C, fiber, folic acid and flavonoids in spinach are very useful in fighting cancer cells. Spinach can reduce the risk of cancer, especially in breast cancer, uterine cancer, prostate cancer, skin cancer and stomach cancer. Besides that, spinach nutrition is also useful for maintaining digestion, maintaining bone health so that osteoporosis does not occur, healthy eyes, namely protecting the eyes from the bad effects of ultraviolet rays and cataracts that occur due to age.


**Figure 1**. Spinach and chemical formula of Vitamin C

Vitamin C or ascorbic acid is a water-soluble antioxidant. Vitamin C has a molecular weight of 176.13 with the molecular formula $C_6H_8O_6$ in the form of white crystals. Vitamin C readily oxidizes reversibly to form dehydro L-ascorbic acid and loses 2 hydrogen atoms. Vitamin C is one of the essential vitamins because humans cannot produce vitamin C in their own bodies, vitamin C must be obtained from outside the body. [21].

Currently, hydroponic vegetables are more in demand by the public. The advantages of hydroponic vegetables are: planting can be done without depending on the season, have better quality, more secure cleanliness, more efficient use of fertilizers, more practical maintenance, free of pesticides and require less labor. Hydroponic cultivation consists of two systems, namely the

substrate and non-substrate hydroponic system. One of the systems contained in hydroponic cultivation is the wick system [3]. Various vegetables can be cultivated hdiroponically, one of which is spinach.

Spinach is a tropical leaf vegetable that is popular with people because of its high nutritional value, especially carotene, lime, iron and folic. It tastes good, is soft and can improve digestion. The greener the color of the vegetables, the more carotene content they contain, such as broccoli which also contains other benefits such as vitamin C, folic and minerals. Meanwhile, sprouts such as bean sprouts are quite rich in vitamin E [4].

Based on the above, I, with this research, would like to provide information to the public in general, about the comparison of general nutritional content and vitamin C content in particular, spinach cultivated hydroponically and spinach cultivated non-hydroponically. The purpose of this study was to determine the comparison of the nutritional content of spinach cultivated hydroponically and non-hydroponically.

## 2. Method

This research is a descriptive study, which was conducted in May-July 2020 at the Plant Physiology Laboratory, Department of Biology, Universitas Negeri Padang. The tools and materials used in this study were mortal pestle and pestle, spatula, volumetric flask, 250 ml and 100 ml measuring flask, drop pipette, glass funnel, stirring rod, gauze, UV-vis spectrophotometer, analytical balance, cuvette, blue. tips, micro pipette. The ingredients used are spinach, distilled water, 750 gr of vitamin C tablets (ipi).

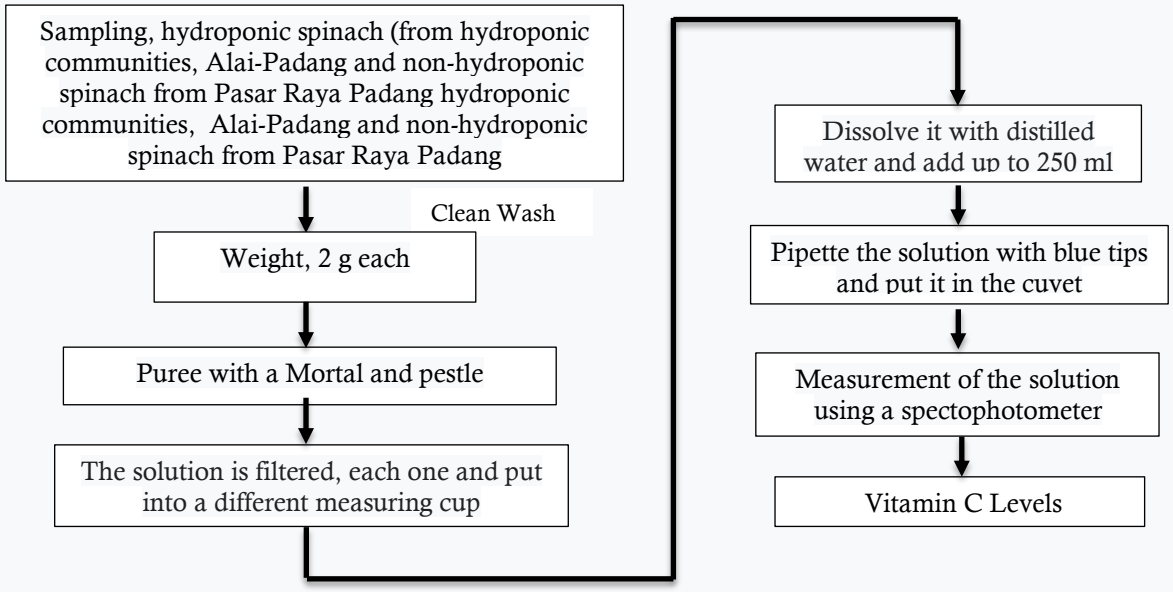


**Figure 1**. Schematic of research

The steps taken in this study were sample preparation, samples of hydroponic spinach were obtained from the West Sumatra hydroponic community in Alai Padang, while non-hydroponic parrots were obtained from Pasar Raya Padang. The analysis carried out on the sample is:

### 2.1. Vitamin C Measurement

The main ingredients used in this study were hydroponic spinach which was obtained from the hydroponic community of West Sumatra in Alai, and non-hydroponic spinach obtained from Pasar Raya Padang.

The tools needed during the study to measure the content of Vitamin C, namely: Erlenmeyer 100 ml, 10 ml measuring pipette, 100 ml measuring flask, glass funnel, 50 ml burette, spray bottle, analytical balance, feeder, filter paper and cotton. Materials needed Hydroponic spinach and non-hydroponic spinach samples, 1% starch solution, 0.01 N iodine solution and Aquades.

The material is crushed until a slury is obtained. Weigh 10 grams of slury, put in a 100 mL measuring flask, and dilute it to the limit mark. Filter using a cotton ball, the obtained filtrate is put into 10 mL Erlenmeyer. Add 1% starch solution with titration quickly using 0.01 iodine solution N until a discoloration occurs (blackish blue color).

Calculation:

$$A = \frac{\text{mL Iod } 0{,}01 \text{ N} \times 0{,}88 \times p}{\text{gram sample}}$$

A = mg vitamin C per gram of material
p = amount of dilution
Note: Use IPI vitamin C as a comparison

### 2.2. Vitamin A Measurement

Spinach weighs 100 g. Grind each ingredient then squeeze it with a filter cloth and take 25 mL. Add distilled water to mark the limit on the 100 mL flask. Then filtered with filter paper. The 10 ml filtrate was heated at 40-60ºC and 1 mL KOH was added. The solution was extracted using petroleum ether and 92% methanol in a ratio of 1: 1, then shaken. The resulting solution was re-extracted with 10 ml of methanol to separate the bottom layer; monohydroxy-carotene soluble in methanol and topcoat; carotene is soluble in petroleum ether [2], for measurement of light absorption. Separation is carried out with a separating funnel, and in the top layer with petroleum ether as a solution; measured absorbance at a wavelength of 450 nm.

Determination of β-carotene levels, using a standard solution of pure β-carotene (5 mg / ml): 10 mg β-carotene standard was dissolved in 2 ml of the petroleum ether-acetone (1: 1) mixture. The solution is diluted with a petroleum ether-acetone (10: 1) mixture to 25 ml. Each volume variation is 0, namely without extract, 0.2 mL, 0.4 mL, 0.6 mL, 1.0 mL of extract into a 25 ml volumetric flask. Each was diluted with petroleum ether-acetone (10: 1) mixture to mark the limit. Determined the level of vitamin A in the sample based on the standard curve obtained. The absorbance obtained from the sample and the concentration / concentration in the sample is [7].

**% Carotene = [(mg / 100)/sample weight/100] x fp1 x fp2 x 100**

### 2.3. Vitamin B Measurement

The tools needed are; test tube, dropper pipette, bunsen, test tube rack, 500 ml glas beaker, stirring rod. Materials for vitamin B testing, 1% Thiamin solution (50 ml), 6 N NaOH solution (50 ml), Pb - acetate solution 10% (50 ml).

Prepare the tools and materials to be used, put 10 drops of 1% thiamin solution into the reaction tube, add 10 drops of pb - acetate solution 10% and 1 ml NaOH 6 N, mix well, then pay attention to

the yellow color occurs, then, heat, so that a black brown color deposits will appear which indicates a positive B vitamin.

## 3. Results and Discussion

From the research that has been carried out, it is found that spinach nutrition is cultivated hydroponically and non-hydroponically. In table 1.presented the nutritional content of spinach cultivated hydroponically.

**Table 1.** Hydroponic spinach nutritional content

| Nutrisional Content | Total | Nutrisional Content | Total |
|---|---|---|---|
| Energy | 36 kkal | Fosfor | 67 mg |
| Protein | 3.5 g | Iron | 3.9 mg |
| Fat | 0.5 g | Vitamin A | 6.090 ug |
| Carbohydrate | 6.5 g | Vitamin B | 0.08 mg |
| Calsium | 267 g | | |
| Water | 87 g | | |

From Table 1, it can be seen that the complete and complex nutritional content of hydroponic spinach, because leafy vegetables have an important role in human nutrition, especially as a source of vitamins (A, B, C. E), minerals and dietary fiber. Vegetables have various nutritional values according to environmental factors, different varieties, cultivation practices, harvesting stages, storage methods, processing and preparation [15].

**Table 2.** Non Hydroponic spinach nutritional content

| Nutrisional Content | Total | Nutrisional Content | Total |
|---|---|---|---|
| Energy | 45 kkal | Vitamin B2 | 9,15 mg |
| Protein | 3,5 g | Niasin | 0,7 mg |
| Fat | 0,5 g | | |
| Carbohydrate | 6,5 g | Ascorbic Acid | 60 mg |
| Calsium | 267 mg | Vitamin K | 483 ug |
| Fosfor | 67 mg | Vitamin A | 9400 ug |
| Iron | 3,9 mg | Folat | 194 ug |
| Retinol | 1827 mcg | Natrium | 131 mg |
| Tiamin | 0,08 mg | Calium | 285 mg |
| Water | 92,2 g | Betakaroten | 4080 ug |
| Fiber | 0,7 g | | |

Sources of Nutritional Information: Various publications of the Ministry of Health of the Republic

In the data obtained, the nutritional content found in hydroponic spinach and non-hydroponic spinach has differences such as energy in 36 kcal hydroponic spinach, whereas in non-hydroponic spinach the energy is 45 kcal, other different content can be seen from the water content, hydroponic spinach has more water content than non hydroponic spinach. Whereas in the results of the study in table 3, it can be compared that the content of non-hydroponic vitamin C is higher than hydroponic spinach, this can be due to Vitamin C which is easily oxidized causing Vitamin C to be easily damaged [6].

**Table 3.** Vitamin C levels in hydroponic spinach and non-hydroponic spinach samples

| Sample | | Vitamin C level (ppm) |
|---|---|---|
| Spinach | hidroponic | 1,429 |
| | hidroponic | 1,466 |
| | non hidroponic | 1,589 |
| | non hidroponic | 1,606 |

Vegetables with the hydroponic method have the same nutritional value as vegetables grown with soil media, the carotenoid content in hydroponic vegetables is lower than vegetables with conventional planting methods. The carotenioid content of hydroponic vegetables is lower than conventional ones, such as beta-carotene and lutein are plant compounds that can benefit human health. It can be said that the difference in nutritional content in different growing media is not much different.

## 4. Conclusion

From the research that has been done, it can be concluded that the vitamin C content of spinach cultivated hydroponically is 1.45 ppm on average, while the vitamin C content of spinach cultivated non-hydroponically is 1.60 ppm on average. Based on the results obtained, the vitamin C content of spinach cultivated hydroponically is lower than the vitamin C content of spinach cultivated non-hydroponically.

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