

## Study on factors affecting the production process of *Canned Asparagus*

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**Abstract:** Asparagus is a food with many nutrients, commonly used in its processed form. This vegetable is a rich source of antioxidants including vitamin C,  $\beta$ -carotene and minerals like zinc, selenium, and manganese. Especially the Glutathione present in asparagus has a strong antioxidant effect. They participate in the body's reactions with a catalytic role, against the excess production of free radicals, against the process of cell death, inhibiting the aging process, and smoothing the skin. However, it is not widely used and well known. The objective of this paper was studying the production conditions of canned products from asparagus. This study could give more options for producers. Canning fruits and vegetables is one of the methods that can extend the shelf life. Asparagus products are obtained after performing the following steps: blanching temperature ( $90^{\circ}\text{C}$ ), blanching time (20 seconds), ratio (salt 3%, acetic acid 1.29% and sugar 9.71%), pasteurization time (15 minutes), sterilization temperature ( $85^{\circ}\text{C}$ ). Canned Asparagus has a grayish-yellow color during storage.

**Keywords:** Canned Asparagus; canned vegetables; sterilization.

### I. INTRODUCTION

Asparagus (*Asparagus officinalis* L.) is a plant known as a source of herbs capable of supporting the treatment of many different diseases, antioxidant, anti-aging, beautifying skin, preventing cancer, ...[9] Asparagus is a vegetable with high nutritional value that is very popular in the West as well as in the East. Native to Europe, North Africa and Western Asia, cultivated as a plant crop [1].

Asparagus is a high-quality vegetable with high nutritional content, very popular in both the West and the East. Asparagus is native to Europe and North Africa, West Asia and it is cultivated as a plant variety [1][2]. In Western European countries where there is a lot of demand for asparagus, but due to conditions cold climate, each year can only be planted in spring and yield is also not high enough to meet the demand. Particularly in Vietnam, especially Da Lat (Lam Dong) where the climate is temperate year round, so it is very suitable for growing and harvesting asparagus all year round major economic source for growers. From 1960 to 1970, many regions of the country had grow asparagus for export processing such as Dong Anh (Hanoi), Kien An (Hai Room), Long Xuyen (An Giang). Currently, the import market of asparagus is mainly Western European countries, up to hundreds of thousands of tons. Domestic restaurants now also have a need to consume these foods asparagus products [3].

Asparagus is considered a vegetable that contains a lot of fiber, water and vitamins. Asparagus is a rich source of antioxidants including vitamin C,  $\beta$ -carotene and minerals such as zinc, selenium, and manganese. Asparagus is not only rich in nutrients, but it also contains biologically active substances that have positive effects on human health. Currently, asparagus products are quite diverse in the world and in developed countries, however, in Vietnam, asparagus is still a strange raw material for everyone, they are only known to be concentrated in one place. certain number of regions. Asparagus is mostly used in fresh form and processed in the form of food used in cooking, they have not been widely used through business models as well as production [4].

Canned vegetables are fruits and vegetables that have been preliminarily cleaned and then canned. Several methods are used such as cooking, bactericidal, drying, vacuuming, ... etc. to kill bacteria as well as remove some of the original properties. Canned vegetables still contain a lot of fiber similar to fresh vegetables, good for digestive system health. More oxidizing compounds are produced after heating to canning [4][5].

Canned asparagus products aim to diversify products from asparagus in Vietnam. Besides, consumers have closer access to products from asparagus - a new food ingredient here.

## II. MATERIAL AND METHODS

### 2.1 Material

Asparagus was collected from Hoa Vang (Da Nang), Dien Ban, Que Son (Quang Nam), Quang Ngai. Asparagus has medium length: 19 - 23cm.



Fig1.Greenasparagus

### 2.2 Methods

#### 2.2.1. Method of determining moisture [6]

+ 2g of raw materials into a petri dish (dried and known in advance). Then, drying at 105°C, within 3 hours. Finally, determined the mass of the material after drying.

$$X = (m_1 - m_2) / m_1 \cdot 100\%$$

X: Humidity, %

$m_1$  is the mass of material before drying, g

$m_2$  is the mass of material after drying, g.

#### 2.2.2. Determination of Vitamin C Concentration by Titration [7]

Cut a 100 g sample into small pieces and grind in a mortar and pestle. Add 10 mL portions of distilled water several times while grinding the sample, each time decanting off the liquid extract into a 100 mL volumetric flask. Finally, strain the ground vegetable pulp through cheesecloth, rinsing the pulp with a few 10 mL portions of water and collecting all filtrate and washings in the volumetric flask. Make the extracted solution up to 100 mL with distilled water. Alternatively, the 100 g sample of vegetable may be blended in a food processor together with about 50 mL of distilled water. After blending, strain the pulp through cheesecloth, washing it with a few 10mL portions of distilled water, and make the extracted solution up to 100 mL in a volumetric flask.

#### Calculation:

+ Calculate the average volume of iodine solution used from your concordant titres

+ Calculate the moles of iodine reacting.

+ Using the equation of the titration (below) determine the number of moles of ascorbic acid reacting. ascorbic acid + I<sub>2</sub> → 2 I<sup>-</sup> + dehydroascorbic acid

+ Calculate the concentration in mol L<sup>-1</sup> of ascorbic acid in the solution obtained from vegetable. Also, calculate the concentration, in mg/100mL or mg/100g of ascorbic acid, in the sample of Asparagus.

#### 2.2.3. Sensory assessment by scoring method [8]

Determine the degree of difference in the sensory properties of the sample. The tester is given a taste and score for a specific sensory property previously stated. Use a scale of 0 - 5 points

The tester is given multiple samples at a time, and is asked to score each sample according to defined organoleptic properties. The pattern is encoded, the number of occurrences and the position of occurrence are the same for each sample

## III. RESULTS AND DISCUSSION

### 3.1. The chemical composition of the Canned Asparagus

In our study, the chemical composition of the *Canned Asparagus* presented in Table 1:

Table 1. Chemical composition of the *Canned Asparagus*

Chemical composition	Humidity	Totalsugar	Vitamin C	Ash
Content (%)	92.01 ± 0.05	5.84 ± 0.07	57.20 ± 0.04 (mg)	1.31 ± 0.03

From the table of chemical composition of Asparagus, Table 1 shows that the main chemical composition of asparagus is water (accounting for 92.01%). Besides, asparagus also contains other important ingredients such as vitamin C (57.2mg), sugar (5.84%), minerals (1.31%). Asparagus can be used to produce asparagus products to diversify products. With its high nutrient content, asparagus can create refreshing products, providing a good source of nutrients, suitable as raw materials for canned food products.

**3.2. Study on the effects of blanching temperature and time on raw materials**

The temperature and time of blanching affect the inhibition of redox enzymes, preventing the blackening of the raw materials. On the other hand, making the asparagus tough and easy to fold and kill good microorganisms, but will increase the oxidation of chlorofil, causing the product to have bad color and high loss of nutrients, causing protopectin to be hydrolysed to pectin. soften the structure [9]. In contrast, the blanching temperature is too low at 60 0 C, which prolongs the blanching time, adversely affecting the color as well as the structure and nutritional composition of the raw materials.

Asparagus after processing, will be cut 12cm from the top to the stem. In this study, we investigated the blanching process with temperatures of 60 0 C, 70 0 C, 80 0 C, 90 0 C, 100 0 C and time of 20s, 30s, 40s, 50s, 60s. The results of the study are shown in Fig 2.

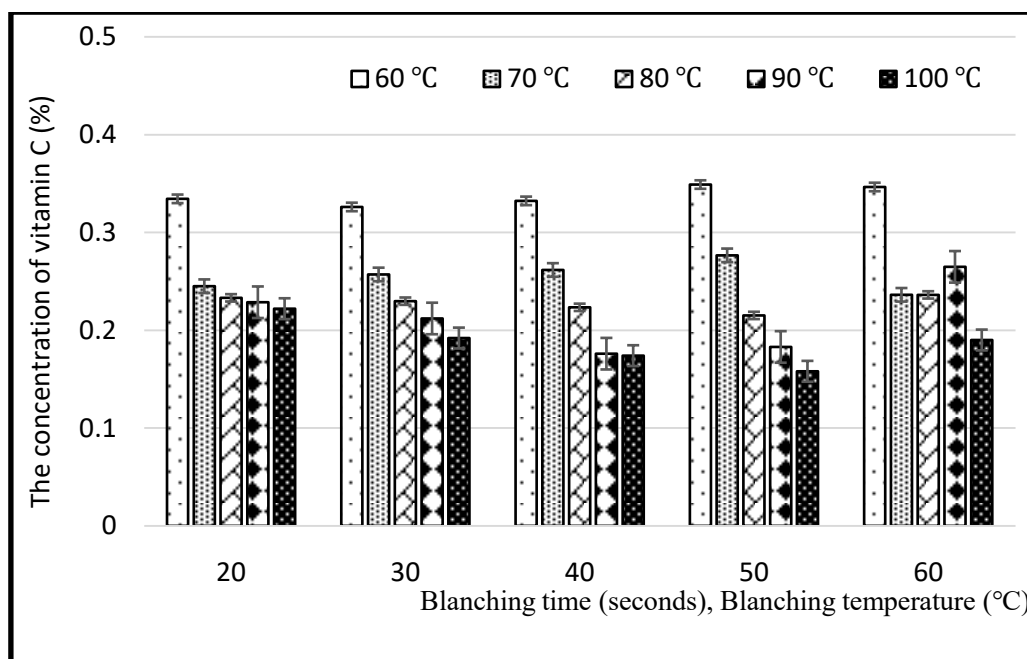


Fig 2. The content of Vitamin C of the sample after blanching

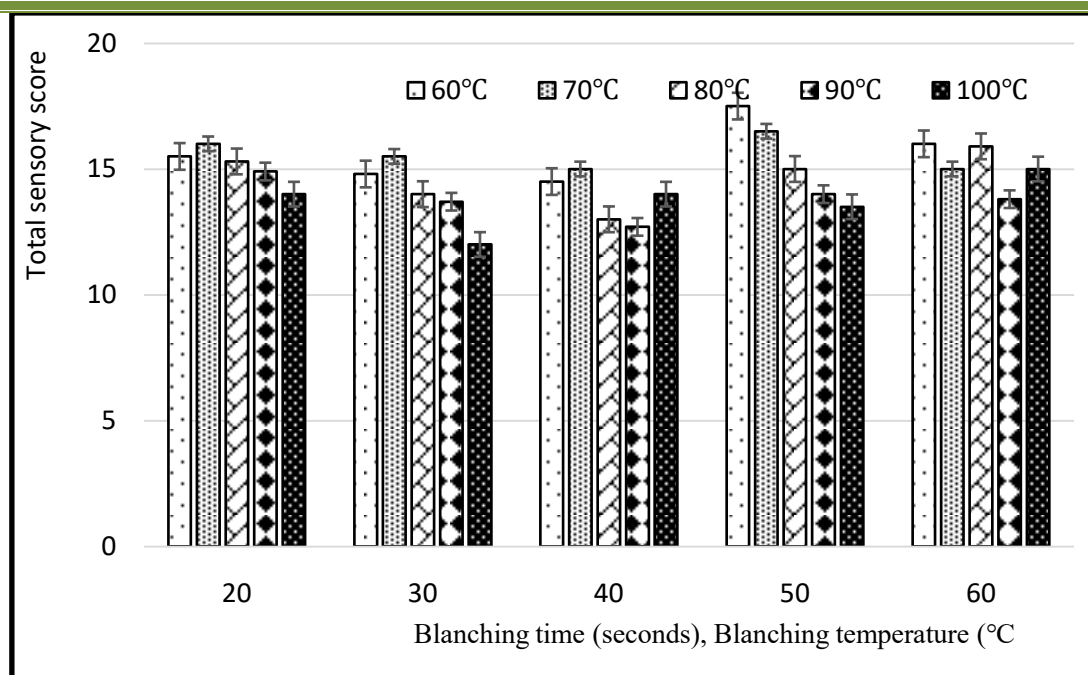


Fig 3. Effect of blanching (time, temperature) of asparagus on sensory value of products



Fig 4 Asparagus after blanching

From the research results (Figure 2; 3; 4), after surveying at different blanching times and temperatures, we found that at blanching times of 40, 50, 60 seconds, the sensory scores were reduced.. However, at a temperature of 90 0 C for 20 seconds gives the best sensory scores.

Under different conditions, the vitamin C content and sensory scores of asparagus changed differently. Under the same temperature conditions, the greater the time, the higher the ability to kill microorganisms [9]. From the above results, we choose a temperature of 90 0 C and a time of 20 seconds to blanch the ingredients before packing.

### 3.3. Study on the influence of salt, sugar, and acetic acid ratios in tapwater

The salt concentration affects the sensory quality of the product, when increasing the salt concentration in the selected range, the sensory quality of the product increases [10]. Concentrations of sugars and acids interact with each other, affecting sensory quality. Sugar reduces the sour taste of acid when combined in an appropriate ratio will make the product taste harmonious. In this study, we conducted a survey on the ratio of salt 2.5% 3% 3.5%, sugar + acetic acid (sugar:acetic acid = 7.5:1) 9%, 10%, 11%, 12% [5].

Asparagus after blanching is placed in a glass box, at the same time, we cook the pickling solution to a temperature of 80°C and then pour the pickling solution [9]. Observe the change in color as well as taste of the product. The results are shown in the graph Fig 5.

According to the obtained results, it can be seen that, at a salt concentration of 2.5%, the sensory points gradually increase with the ratio of sugar + acid: 9%, 10%, 11%, 12%, the salt content is low, so the taste will not be strong. At the salt concentration of 3.5%, the sensory score decreased at the concentration of sugar + acid: 9% ÷ 11%, the salt content was too much compared to acetic acid, giving the product a salty taste. When increasing sugar + acid to 12%, the sensory score decreased again. At a concentration of 3% salt, sugar + 11% acid, the product has the highest sensory score, the sample has a harmonious sour, sweet, and salty taste, the most acceptable color, taste and door state. The water bath solution gives the product better quality than other ratios. Therefore, we choose the rate of salt 3% acetic acid 1.29% sugar 9.71%. Table 2. Sensory evaluation results of the sample (the ratio material: water (1:4, g/ml)).

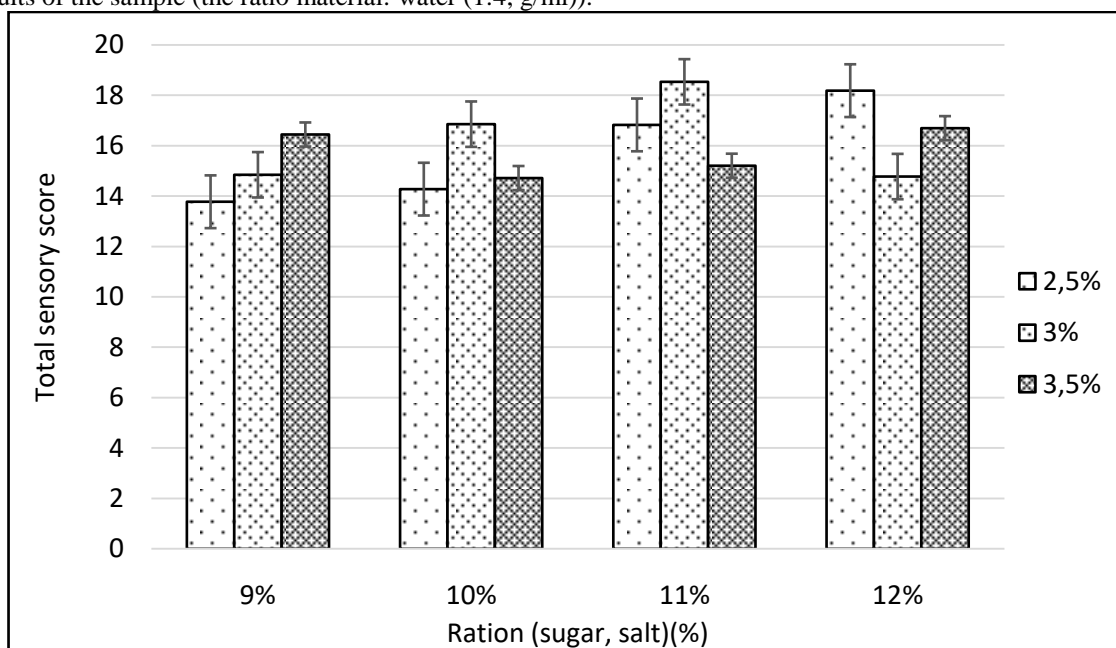


Fig 5. Effect of sugar, salt, and acetic acid ratios on product sensory scores

### 3.4. Study on the effect of pasteurization time and temperature

Pickled asparagus is a high acid canned food, with a very low pH, which makes the heat resistance of pathogenic bacteria worse, and also inhibits the bacteria that cause rot and spoil the product [8]. For long-term storage, pasteurization is required. It is necessary to choose the right pasteurization temperature and time to ensure the digestibility of the product, the product has both sensory quality and can be preserved for a long time [5]. Asparagus after pouring the solution should be pasteurized at 85°C, in this study, we investigated the pasteurization time of 10, 15, 20, 25, 30 minutes [9].

Table 2 Product description by pasteurization time

Heat retention time (minutes)	Sensory description
10	The state of asparagus is very good, the asparagus is crispy, not crushed, but during this time it is not enough for the taste of the asparagus and the marinade to blend together, so the taste is less harmonious when eaten.
15	The state of asparagus is very good, the bamboo shoots are crispy, not crushed, the color is very beautiful, the taste of the marinade and asparagus blend together, the asparagus when eaten has a more harmonious taste.
20	Asparagus is still in good condition, but when eating asparagus is a bit soft, with tiny residues, the product still has good sensory quality. The condition of the asparagus is not good, there are tiny residues, the asparagus is slightly dark, the smell of cooking, the asparagus is soft, the water is slightly cloudy.
30	Asparagus is soft, turbid water has large residue, cooking smell, sensory value of the product is reduced

Table 3 Table describing the change in sensory quality of products with storage time

Storage time (days)	Sensory description
0	After pasteurization, the product is bright yellow, the water is clear, the female part is pushed up to the edge of the box, the taste is light.
5	The product has a greenish-yellow color, the clear water is slightly turned to light yellow due to the water coming out of the asparagus, the taste is relatively harmonious.
10	The product has a slightly yellowish green color, the water is slightly yellow, the female part and the water have begun to stabilize, relatively evenly distributed in the bottle, harmonious taste
15	Asparagus is soft, turbid water has large residue, cooking smell, sensory value of the product is reduced
20	The product is yellow-green-gray in color, the female part and the water are evenly distributed, the water is slightly cloudy due to the scattered debris from the asparagus.



Fig 6 Canned asparagus products

The results from (Fig 6, Table 2 and Table 3) show that the product in the early stages of storage is not stable, still under the influence of the difference of substances in the brine water, so the changes occur strongly. , the later changes occur less and more stable. The graph also shows that the vitamin C content is greatly reduced because vitamin C is easily oxidized and lost by blanching and pasteurization. During the storage period asparagus decreases a small amount, the later the diffusion of vitamin C slows down and will stop when the vitamin C content between the pickling juice and the asparagus is equal.

#### IV. CONCLUSION

Canned asparagus products are convenient products for consumers. At the same time, the product helps diversify food products in Vietnam. During the study of the production process of canned asparagus, the temperature conditions were carried out below 100 degrees Celsius to maintain the vitamin C content in the product. In addition, in order to perfect the process of canned asparagus, in the future it is necessary to study methods of product pasteurization, identify oxidizing substances from the product in order to improve the value brought from canned asparagus.

#### Acknowledgements

This research was supported from the University of Technology and Education, University of Danang, Vietnam.

#### REFERENCES

- [1]. Inés Arana, Francisco C Ibañez , Paloma Torre . Monitoring the sensory quality of canned white asparagus through cluster analysis. *J Sci Food Agric* 2016, 96(7):2391-9.
- [2]. Isabel Viera-Alcaide, Amel Hamdi , Rafael Guillén-Bejarano , Rocío Rodríguez-Arcos , Juan Antonio Espejo-Calvo , Ana Jiménez-Araujo . Asparagus Roots: From an Agricultural By-Product to a Valuable Source of Fructans. *Foods* 2022, 23; 11(5):652.
- [3]. <https://www.lisado.vn/ban-do-vung-trong-mang-tay-o-viet-nam/>

- [4]. Daniel Drost. Asparagus breeding: Future research needs for sustainable production. REVIEW article Front. Plant Sci., 27 March 2023 Sec. Plant Biotechnology.
- [5]. Eirini Pegiou, Roland Mumm , Parag Acharya, Ric C. H. de Vos , and Robert D. Hall . Green and White Asparagus (*Asparagus officinalis*): A Source of Developmental, Chemical and Urinary Intrigue. Metabolites. 2020 Jan; 10(1): 17.
- [6]. Yeshajahu Pomeranz & Clifton E. Meloan Determination of Moisture. Food Analysis pp 575–601.
- [7]. <https://www.ukessays.com/essays/biology/determination-of-vitamin-c-biology-essay.php#:~:text=Determination%20of%20Vitamin%20C%20Concentration%20by%20Titration.%20Thio%20sulfate%20%28S2O32-%29.%20Starch%20solution%20is%20used%20as%20indicator.>
- [8]. M.A. Drake, Analytical Sensory Tests: Descriptive Sensory Evaluation in Encyclopedia of Dairy Sciences (Third Edition) , 2022.
- [9]. Hà Văn Thuyết, Giáo trình công nghệ rau quả, NXB Bách Khoa – Hà Nội, 2013
- [10]. Nguyễn Trọng Cần, Công nghệ sản xuất đồ hộp rau quả, Đại Học Nha Trang, 2001.