THE PALATABILITY AND ASCORBIC ACID CONTENT OF ASPARAGUS BLANCHED IN THE PRESSURE SAUCEPAN VERSUS THAT BLANCHED IN BOILING WATER

by

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INTRODUCTION

Preservation of foods by freezing is of more interest now than at any time in the past because home freezer cabinets have prompted homemakers to do their own freezing. Since they are interested in obtaining top quality products, they are watching for new developments in this field. Blanching of vegetables for freezing has been considered important for several years. Work has been reported on the blanching of asparagus in boiling water, steam and in a few cases by infrared light, but no work has been noted on the use of the pressure saucepan for blanching asparagus. Recently, housewives have questioned the advisability of using it for this process.

The purpose of this study, then, was to compare asparagus blanched in boiling water with that blanched in the pressure saucepan, on the basis of palatability and ascorbic acid content.

REVIEW OF LITERATURE

The process of blanching, according to Gortner et al (1948), stops the action of oxidative and respiratory enzymes which are largely responsible for toughness, color change, mustiness, flavor loss and deterioration of nutritive value in vegetables. These workers reported that any enzymes present catalyze chemical reactions and must be inhibited by heat if the products are to remain satisfactory during freezing.

The two enzymes which must be inactivated by blanching are peroxidase and catalase. Joslyn and Bedford (1940) noted that the inactivation of peroxidase was related to flavor retention and that scalding in water at 92° C. for four minutes or at 100° C. for three minutes was adequate for blanching asparagus. Their results showed a good correlation between the inactivation of peroxidase by blanching and the flavor of frozen, stored asparagus. Even asparagus showing only slightly positive peroxidase tests developed noticeable off-flavor within several months. Unblanched vegetables including asparagus developed stale hay-like odors and flavors in freezer storage. Catalase was destroyed at a much lower temperature than peroxidase; therefore asparagus blanched just sufficiently to destroy the catalase became stale and hay-like in flavor, Joslyn and Marsh (1940) concluded.

A method of determining adequacy of blanching has been recorded by Tressler and Evers (1943). It is a quantitative test using guaiacol and hydrogen peroxide as the reagents and is reported to have given good correlation with keeping quality of frozen vegetables stored four years. In a study of the peroxidase activity of apple tissue, Reddi, Esselen and Fellers (1950) compared methods of measuring this activity. They concluded, as a result of their experimentation, that they could not comment on the superiority of any one method.

Chemical changes other than enzymatic were discovered in asparagus tissue by Joslyn and Bedford (1940). Color changes occurred as well as changes in texture and flavor. When held at a temperature slightly above freezing, the asparagus developed a bitter taste at the tip of the stalk.

Several methods of blanching have been used with varying degrees of success by many workers in the field. Joslyn and Bedford (1940) believed that steam blanching was superior to water scalding since steam blanching reduced losses of water-soluble vitamins and other soluble nutrients and produced a better flavor. They commented that the scaling of the outer skin was more prevalent in water scalding than in steam scalding. However, the texture of the vegetable blanched in boiling water was superior to that of one blanched in steam.

A list of blanching periods used by several workers and published by Joslyn and Marsh (1938) indicated that a one minute blanch in live steam or a two to three minute blanch in boiling water produced optimum results with asparagus.

Woodroof, Anderson, Cecil, and Shelor (1946) found that asparagus had a delicate flavor easily masked or covered up and a texture sensitive to scalding. The highest quality product was produced when medium stalks were scalded in boiling water one minute and cooled in cold water. When cooled under a fan, the asparagus was wrinkled. That blanched five minutes in steam was overscalded, wrinkled, yellow-green in color and lacked flavor. These workers proved infrared light unsatisfactory for blanching since it imparted a foreign, unpleasant flavor to the vegetables.

Lee and Whitcombe (1945) stated that the use of different types of water in blanching produced no significant differences in the mineral and vitamin content other than an increase in the calcium content of vegetables blanched in hard water.

The ascorbic acid content of fresh asparagus varied from 12.5 to 120 mg per 100 g of the vegetable, according to Gleim, Tressler and Fenton (1944). The same workers also pointed out that the highest value for vitamin C was found in asparagus harvested at the end of the season.

Storage facilities before preparation for freezing and length of storage time have an influence on the retention of ascorbic acid. Gleim, Tressler and Fenton (1944) have reported Jones' and Fenton's conclusion that 97 per cent of the vitamin C of fresh asparagus was retained after 24 hours in a mechanical refrigerator at 35° F. In comparison with this study, however, Fitzgerald and Fellers (1938) showed a 20 per cent loss in asparagus stored at 21.1° C. (70° F.) for 24 hours. After storage in an open, wooden crate at room temperature for 24 hours, asparagus tested by Gleim, Tressler and Fenton (1944) had lost 40 per cent of the vitamin C. Work done by Lee and Whitcombe (1945) has shown that a certain part of the vitamin C was susceptible to destruction and if it were not lost during processing it would be during storage.

Fitzgerald and Fellers (1938) found that quick frozen asparagus contained from 9.0 to 32.0 mg of ascorbic acid per 100 g in comparison with 18 to 44 mg per 100 g in the freshly cut vegetable. A high temperature for a short blanching period permitted better retention than long time blanching at either high or low temperatures, according to Wagner, Strong, and Elvehjem (1947).

High temperature blanching for short periods was cited by

Guerrant et al (1947) as being more conducive to higher vitamin retention than low temperature for longer periods. Steam blanched vegetables were found to retain a larger proportion of their original vitamins than those blanched in water.

A loss of 10 per cent of the vitamin C in home frozen asparagus blanched by immersion in boiling water for three minutes was recorded by Gleim, Tressler and Fenton (1944). Fellers et al (1934) reported no loss of vitamin C from commercially frozen asparagus.

Quick frozen vegetables cooked in the pressure saucepan have the highest vitamin C retention, McIntosh, Tressler and Fenton (1940) stated. They believed that if just enough water to almost cover the vegetable were used in cooking, an increased vitamin C retention would be found. Frozen asparagus cooked in a large amount of water retained 63 per cent of its vitamin C, while that cooked in a small amount retained 84 per cent.

Loeffler and Ponting (1942) perfected a method for the rapid determination of vitamin C in fresh, frozen or dehydrated fruits and vegetables. The sample was disintegrated rapidly in a Waring Blendor in dilute metaphosphoric acid. With the use of a photoelectric colorimeter the decolorizing effect of the extracted vitamin C on the indophenol dye was measured.

Joslyn and Bedford (1940) studied packaging and its effect on the flavor of the product. They recommended that asparagus be packed dry in hermetically sealed containers. To prevent moisture loss and drying out, Tressler and Evers (1943) suggested the use of moisture-vapor-proof material for packaging.

Hustrulid and Winter (1943) pointed out the necessity of maintaining a temperature of 5° F. or less in the freezer locker. They believed that the constancy of the temperature below 5° F. was not important if the product were properly selected, prepared, and packaged. Yet, Gortner, Erdman, and Masterman (1948) contended that fluctuating temperatures were to be avoided in frozen food storage for moisture loss often resulted from temperature variation.

EXPERIMENTAL PROCEDURE

All work in this study was carried out in the research laboratories of Calvin Hall.

In planning the experiment it was necessary to divide the work into two periods of three days each. The first period is discussed as Series I and the second as Series II.

Work schedule for preparing and freezing asparagus*

	Sat.		Mon.		Tues.	
	Series					
	I	II	I	II	I	II
Number of						
Samples blanched in						
Boiling water	46	0	0	44	20	23
Pressure saucepan	0	42	39	0	20	23
Samples tested blanched						
for Ascorbic Acid	4	4	4	4	4	4
Palatability	0	0	0	0	0	0
Samples tested unblanched						
for Ascorbic Acid	4	4	4	4	4	4
Palatability	2	2	2	2	2	2
Samples stored for later testing	30	30	30	30	30	30
Extra packages stored	12	2	5	10	6	12
Stalks used for the shear test	12	21	20	11	15	18
Stalks used for the peroxidase test	12	21	20	11	15	18

*The asparagus was obtained on Friday, Sunday, and Monday for use the following day.

Equipment

The equipment used included enameled dishpans, a refrigerator, a cutting box, cheesecloth, a Harvard trip balance, a nine-quart preserving kettle, a four-quart Mirromatic Pressure saucepan with rack, a timer, a gas plate, heavy pliofilm, Permasel locker tape, freezer lockers, a Warner-Bratzler shear apparatus, a mortar and pestle, cotton milk filters, beakers, plain test tubes, pipettes, funnels, an analytical balance, watch glasses, a Waring Blendor, wash bottles, flasks, a Klett-Summerson photoelectric colorimeter, Klett tubes and one-pint heavy aluminum saucepans with tight-fitting lids.

Reagents Used

The reagents used included 0.5 per cent guaiacol in 50 per cent ethyl alcohol solution, 0.08 per cent hydrogen peroxide, clean sand, crystalline ascorbic acid (Cebione Merck), two-six dichlorophenol indophenol, metaphosphoric acid pellets, distilled water and butyl stearate.

Preliminary Work

The asparagus was obtained from a single source each evening previous to the day of freezing. Only graded asparagus, approximately one-half inch in diameter at the base, was used. Several bunches were placed upright in dishpans. Each bunch was given a half twist to spread the stalks thus ensuring optimum circulation of air around each. The dishpans were covered with cloths wrung out of cold water, and refrigerated overnight.

The following morning, the asparagus was removed from the refrigerator, washed quickly and drained thoroughly on cheesecloth. The stalks were cut into seven-inch lengths and 100 gram portions weighed into cheesecloth bags for blanching.

Blanching

Two methods of blanching were used.

Boiling Water Method. Four portions at a time were blanched in nine quarts of boiling water. The water was allowed to come to a full, rolling boil; the samples were put in the water and blanched two minutes.

Pressure Saucepan Method. Two portions at a time were blanched in the pressure saucepan. The pan contained enough water to just cover the rack in the bottom of the pan. The saucepan was placed over the gas flame until the water boiled. Then the asparagus was added, the lid screwed in place. As soon as steam began to escape, the five-pound pressure gauge was put in place and the blanching continued for 30 seconds.

Two extra stalks were blanched with each set of samples by each method; one stalk was to be used for the fibrousness test and the other for the peroxidase test.

Cooling, Packaging and Freezing

Immediately after blanching, the asparagus was plunged into ice water for one minute, then drained on cheesecloth, dried and packaged in heavy pliofilm. A label was inserted into each package which was drugstore wrapped and sealed with locker tape. The samples were frozen at -10° F. and stored at 0° F.

Shearing Test

The blanched asparagus stalk was cut in two places with the Warner-Bratzler shear apparatus at three-quarters and one and one-half inches from the butt end. A special knife with a circular hole was used. The figures were averaged and recorded in

Table 1. The pounds pressure required to shear the stalks was an indication of the fibrousness of the asparagus.

Peroxidase Test

The peroxidase test used was one developed at the Western Regional Research Laboratory and reported by Tressler and Evers (1943). The tissue to be tested was cut in small pieces and ten-gram samples were weighed. Thirty cc of distilled water were poured into a graduate cylinder. The sample, approximately one tablespoon of clean sand and some water were ground in a mortar to give the desired consistency. The remainder of the water from the graduate was added, mixed, and the mixture filtered through a cotton milk filter. Two cc of filtrate and 1.0 cc of guaiacol were added to 20 cc of distilled water in a test tube without mixing, then 1.0 cc of hydrogen peroxide was added. The tubes were quickly inverted three times to mix. If no change of color developed within three and one-half minutes the test was considered negative and the product adequately blanched. A blank tube containing guaiacol, water and the filtrate was prepared for comparison.

Palatability Tests

Palatability tests were made on the fresh asparagus and at intervals of two weeks, one month, two months, three months, and six months. Aluminum saucepans with tight-fitting lids were used to cook the samples. The frozen stalks were cut in half, the butts dropped into 100 cc of boiling water with one-quarter teaspoon of salt and cooked a total of 13 minutes after the water returned to the boil. Tips were added three minutes after the butts and cooked ten minutes.

A palatability committee of seven judges scored the asparagus using Form I. Scores were recorded and tabulated.

Ascorbic Acid Tests

The samples were analyzed for ascorbic acid by a modification of the Loeffler-Ponting method.

Solutions Needed. For the colorimetric method of ascorbic acid analysis three solutions were needed.

A stock solution of 10 per cent metaphosphoric acid was made by dissolving 100 g of metaphosphoric acid pellets in less than one liter of distilled water. This was transferred to a one-liter volumetric flask and the volume brought up to 1000 ml. For use in extraction, 100 ml of this solution were added to 900 ml of distilled water to make a one per cent metaphosphoric acid solution.

The ascorbic acid solution used for the standardization of the dye was prepared by weighing out exactly 25 mg of crystalline ascorbic acid (Cebione Merck). The ascorbic acid crystals were brushed through a funnel into a 250 ml volumetric flask containing a small amount of freshly prepared one per cent metaphosphoric acid. The funnel was rinsed and the solution made up to volume.

Two-six dichlorophenol indophenol dye solution was prepared by dissolving ±10 mg of the dye in hot distilled water, filtered into a 500 ml volumetric flask and the filter paper washed with more hot water. The solution was cooled and made up to volume. Because an aqueous solution of the dye changes rapidly at high temperatures, it was kept in the refrigerator. If kept longer than three days, the dye solution was restandardized before the samples were tested.

Standardization of the Dye Solution. For all standardizations and extractions, care was taken to have all reagents at room temperature. For standardization of the dye, dilutions of the stock solution of ascorbic acid were made so there were three solutions with concentrations of 3 micrograms per ml, 4 micrograms per ml and 5 micrograms per ml, respectively. To prepare these concentrations 3 ml, 4 ml, and 5 ml of the stock solution were pipetted into each of three 100 ml volumetric flasks before making up to volume with freshly made 1.0 per cent metaphosphoric acid.

Next, the Klett-Summerson photoelectric colorimeter was calibrated to zero with a Klett tube containing 5.0 cc of distilled water.

Five ml of dye solution were pipetted into each of eight Klett colorimeter tubes.

To one of these tubes, five ml of a one per cent metaphosphoric acid solution were added by means of a five ml volumetric pipette.

To mix these thoroughly, the tube was inverted quickly three times and placed in the colorimeter.

The reading was taken 15 seconds after the beginning of the addition of the acid.

Checks were run on each test. The reading of the dye plus the acid is referred to as the "blank" reading.

Standardization of the Ascorbic Acid. The same procedure was followed for each of the ascorbic acid solutions. Five ml of each of the various concentrations of ascorbic acid were pipetted into the dye rather than into the metaphosphoric acid solution. Checks were run in each case just as in the "blank" reading.

The following relationship was used to calculate the ascorbic acid factor:

$$\text{Ascorbic Acid factor} = \frac{\text{Concentration of Ascorbic Acid}}{\text{Blank reading} - \text{ascorbic acid reading}}$$

The average of the ascorbic acid values for the three concentrations gave the ascorbic acid factor used in calculating the amount of ascorbic acid in the sample.

Method of Extraction

One hundred gram samples of asparagus were used. The stalks were cut in approximately one-half inch lengths and dropped into a Waring Blendor jar containing approximately 400 ml of one per cent metaphosphoric acid and blended for five minutes. To prevent frothing, two or three drops of butyl stearate were added to the mixture before the blending started.

After blending, the mixture was transferred quantitatively to a one-liter volumetric flask and made up to volume. The samples were well mixed and a given portion filtered through fluted paper.

Because the filtered samples were somewhat turbid, they were filtered three times. The refiltered samples were used for the ascorbic acid determination.

Analysis of Filtrate

Dilutions were used for all the samples of asparagus since it was desirable that the readings fall within the range used for the dye standardization. A five in fifty dilution proved satisfactory in all cases. Fifty ml volumetric flasks were used to make up the dilutions. Five ml of the extract were pipetted into the flask and made up to volume with one per cent metaphosphoric acid. The diluted solutions were all well mixed.

The method of analysis was similar to that used for the standardization of the dye. Three tubes were needed for each determination.

Five ml of distilled water were pipetted into one tube and five ml of dye into each of the other tubes.

Five ml of the unknown solution were added to the tube containing the distilled water, the tube inverted three times and placed in the machine to set it to zero with this blank. This automatically corrected for turbidity and the normal color of the solution.

Five ml of the unknown were added to each of the other tubes and readings were taken 15 seconds after the beginning of the addition of the acid.

Duplicate readings were made for the ascorbic acid determinations. These readings were referred to as the unknown readings in determining the ascorbic acid content.

The concentration of the ascorbic acid in mg per 100 g of sample was calculated by the following formulas:

Dye Blank - Unknown Reading = Corrected Unknown.

$$\frac{\text{Ascorbic Acid Factor} \times \text{Corrected Unknown} \times \text{Dilution}}{\text{Aliquot Portion}} = \text{mg ascorbic acid per 100 grams of sample.}$$

DISCUSSION OF RESULTS

All data obtained from the asparagus blanched by two methods were summarized, averaged, and reported in Tables 1 to 10.

Blanching and the Peroxidase Test

The one hundred gram samples of asparagus were enclosed loosely in cheesecloth bags for blanching. With each set of four samples blanched in the boiling water and of two blanched in the pressure saucepan, two extra stalks were blanched. These single stalks were exposed directly to the heat of the boiling water or steam.

The peroxidase tests run on these stalks were negative, indicating that the asparagus was blanched sufficiently. However, when a peculiar hay-like flavor was noted in the samples after two weeks of storage, several packages blanched by each method were removed from the locker and the peroxidase test done on each. At that time, several of the tests were positive. It is now believed that the loose stalks of asparagus, being exposed more completely to the water or steam were sufficiently blanched while some of the others enclosed in the bags were not. The off-flavor then may have been due to inadequacy of blanching. Had a stalk been marked for the peroxidase test and enclosed in the bag with the sample, a more valid indication of peroxidase activity might have been made.

Shearing Test

Fibrousness of the blanched asparagus revealed a fairly wide range within the groups, Table 1. Tests showed the asparagus blanched in boiling water to be less fibrous than that blanched in the pressure saucepan. It is evident from the figures that the asparagus blanched in Series I by either method was less fibrous than the asparagus in Series II. As would be expected, in each series, the asparagus blanched in boiling water was more tender than that blanched in the pressure saucepan.

Palatability

The asparagus was rated by a panel of seven judges who used the scorecard, Form I. Four of the seven judges were present at each testing period. Each of the others missed once. As described in the scorecard, a standard product was given a score of (0).

The data of this work were considered from two standpoints. First the data as a whole were studied; then the two series in which the work was done were studied separately.

The average scores of fresh asparagus at the time of storage were slightly superior (+2) for aroma, appearance and flavor and very slightly superior (+1) on texture, Table 2. In general throughout the study, the palatability scores for the asparagus blanched in the boiling water were somewhat higher than for that blanched in the pressure saucepan.

Palatability of Asparagus Blanched in Boiling Water. After two weeks of storage, this was still rated very slightly superior (+ 1) in all respects, although several judges noted sloughing of the outer skin and a slight stringiness, Table 3.

One month after it was put in storage, the asparagus ranked very slightly superior (+1) on aroma and appearance and standard (0) on flavor and texture. By that time, a stronger hay-like flavor than was present in the fresh asparagus seemed to have developed, as noted by the judges.

A storage period of two months produced samples which were judged standard (0) on aroma and appearance, very slightly inferior (-1) on flavor and texture. The asparagus was more bitter than it had been previously and on one occasion was said to be on the borderline of acceptability.

At the three-month period, no appreciable difference was noted in any of the characteristics judged. Although the skin was still sloughing, one judge commented that the product was better than it had been for several times.

The final testing period of six months showed the greatest changes. The score for aroma had dropped from standard (0) to slightly inferior (-2). At three months the flavor had been standard (0) and at six months it was given a score of slightly inferior (-2). Texture had fallen to slightly inferior (-2) and appearance to very slightly inferior (-1).

From the first testing to the end of the six months' storage period, the asparagus blanched in boiling water dropped from a score of slightly superior (+2) in aroma to slightly inferior (-2), in appearance from slightly superior (+2) to very slightly inferior (-1), in flavor from slightly superior (+2) to slightly inferior (-2) and in texture from very slightly superior (+1) to slightly inferior (-2). The fresh asparagus was acceptable in 97 per cent of the cases while the asparagus after storage of six months was acceptable only 29 per cent of the time, Tables 2 and 3.

<u>Palatability of Asparagus Blanched in the Pressure Saucepan</u>. On the average, this scored the same in appearance as the asparagus blanched in boiling water but lower in aroma, flavor and texture. Throughout the study, the color was found to be more natural, but a greater degree of sloughing was noted by the judges, Tables 2 and 3.

After only two weeks of storage, an off-flavor was detected. The asparagus showed indications of sloughing and was quite stringy. Nineteen out of 40 actual samples tasted were called unacceptable. Comparing these comments with the fibrousness scores in Table 1, a close relationship is evident.

Just as for the two week storage samples, the products judged after one month of storage were scored standard (0) on aroma. The appearance had decreased from very slightly superior (+1) to standard (0) at one month, the flavor had increased from slightly inferior (-2) to very slightly inferior (-1) and the texture remained practically the same. One judge commented on a soapy flavor. No explanation for the improvement in flavor is known. Paul, Wiant and Robertson (1949) noted a similar improvement with storage.

Storage of two months rendered the asparagus definitely unacceptable. The aroma was judged very slightly inferior (-1), the appearance standard (0), the flavor moderately inferior (-3) and the texture standard (0).

After a storage period of three months, the texture became soft and mushy at the tip, and tougher and more stringy at the butt end. However, the asparagus was more acceptable to the judges than it had been at two months.

Six months after storage, the aroma and appearance were rated slightly inferior (-2) as compared with very slightly inferior (-1) at three months. The flavor remained moderately inferior (-3) and the texture very slightly inferior (-1). The asparagus was unpalatable at this time but was scored more acceptable than at two or three months.

The asparagus blanched in the pressure saucepan was scored slightly superior (+2) in aroma when fresh and slightly inferior

(-2) at the end of the six month storage period. The appearance of the product dropped from slightly superior (+2) to slightly inferior (-2) during the same period. Flavor dropped from slightly superior (+2) to moderately inferior (-3) and texture from very slightly superior (+1) to very slightly inferior (-1). After six months of storage, the asparagus blanched in the pressure saucepan was acceptable only 22 per cent of the time.

At least part of the deterioration of the asparagus over the storage period can be attributed to inadequacy of blanching as indicated by the peroxidase test. Because the enzymes were not completely destroyed life processes within the vegetable were permitted to continue and flavor and texture changes resulted. Deterioration was a gradual process in asparagus blanched by both methods.

Palatability of Asparagus Blanched in Boiling Water.

Series I, Tables 4 and 5. After two weeks' storage, the asparagus was rated very slightly superior (+1) on aroma, appearance, flavor, and texture. Eighty-two per cent of the samples was judged acceptable although some sloughing and stringiness were noted by the members of the panel.

At the end of one month of storage, the same score of very slightly superior(+1) was given for each characteristic. In 92 per cent of the cases the product was called acceptable. It was said to be slightly gritty which was probably due to handling of the asparagus and not to method.

Two months of storage yielded asparagus which was judged standard (0) on aroma and flavor, very slightly superior (+1) on appearance and very slightly inferior (-1) on texture. This was acceptable 79 per cent of the time.

All the characteristics scored were again said to be very slightly superior (+1) after the three month storage period, but only 59 per cent of the samples were acceptable to the judges. Some mentioned that the butts were mushy and that sloughing was evident. At this time, as on several other occasions, the judges' scores and the acceptability of the product appear inconsistent.

At the final testing period, after six months' storage, the asparagus had deteriorated. A rating of very slightly inferior (-1) was given on aroma, texture and flavor, and standard (0) on appearance. At that time, only 35 per cent of all samples tasted were judged acceptable. Several judges described the asparagus as mushy, off-flavor, fibrous, shriveled and stringy.

Series II. On the average, the asparagus blanched in boiling water in Series II was not as acceptable as that in Series I.

After two weeks of storage, it was judged very slightly superior (+1) on all characteristics except aroma on which it was rated standard (0). According to the judges, 87 per cent of the samples was acceptable. A slightly bitter taste was noted in several cases.

The cooked asparagus was scored standard (0) on aroma, appearance and texture and very slightly inferior (-1) on flavor after one month of storage. Seventy-four per cent of the samples was judged acceptable. It was reported to have a slightly strong flavor and to be slightly gritty.

At the two month tasting period, the aroma and appearance were still judged standard (0) but the texture and flavor were said to be very slightly inferior (-1). Only 57 per cent of the samples was acceptable.

The flavor seemed to improve slightly after three months' storage and was given an average score of standard (0). Aroma and appearance remained standard (0) and texture very slightly inferior (-1). Of the samples judged 58 per cent was acceptable.

Only 35 per cent of the samples in both series was judged acceptable after six months' storage. In series II, however, aroma was judged slightly inferior (-2), flavor moderately inferior (-3) and appearance and texture very slightly inferior (-1).

Palatability of Asparagus Blanched in the Pressure Saucepan.

Series I. An off-flavor was noted after two weeks of storage and slight sloughing was apparent to the judges. Aroma and appearance were scored very slightly superior (+1), flavor very slightly inferior (-1) and texture standard (0). Only 50 per cent of the samples was acceptable.

At one month there seemed to be an improvement in quality. Flavor was still judged very slightly inferior (-1). Aroma and texture were very slightly superior (+1) and appearance slightly superior (+2). Acceptability had risen to 76 per cent.

The two months' storage period showed the lowest acceptability. The off-flavor seemed to have intensified and none of the samples was judged acceptable. Aroma was scored very slightly inferior (-1) appearance very slightly superior (+1), flavor moderately inferior (-3) and texture standard (0).

At three months a gradual upward trend in acceptability was noted. In this series 12 per cent of the samples was scored acceptable. All characteristics were scored the same as at two months except texture which had dropped to slightly inferior (-2). The judges commented that the asparagus was old, stale, and strong at that time.

After six months' frozen storage the acceptability of the samples had increased to 25 per cent. Aroma was judged slightly inferior (-2), appearance and texture very slightly inferior (-1) and flavor moderately inferior (-3).

Series II. In Series II only 32 per cent of the two weeks samples was judged acceptable. The flavor was scored slightly inferior (-2), aroma and texture standard (0) and appearance very slightly superior (+1).

At one month aroma and appearance were judged standard (0) and flavor slightly inferior (-2) but texture was slightly superior (+1) and acceptability had increased to 35 per cent. Slight fibrousness and grittiness were noted by the judges.

As in Series I, at two months, none of the samples in this series was considered acceptable. Aroma was judged slightly inferior (-2), appearance very slightly superior (+1), flavor inferior (-4) and texture very slightly inferior (-1).

At three months, the asparagus in Series II was said to be sour, bitter and sloughing. Flavor had improved slightly and was judged moderately inferior (-3) but texture had dropped to slightly inferior (-2). Fourteen per cent of the samples was judged acceptable.

At six months a further slight increase in acceptability was recorded and 19 per cent of the samples was said to be acceptable. Aroma and texture were scored very slightly inferior (-1), appearance and flavor slightly inferior (-2).

Ascorbic Acid Determinations

All determinations were made by a modification of the Loeffler and Ponting method.

There was considerable variation in the ascorbic acid content between the asparagus blanched in the pressure saucepan and that blanched in boiling water, Tables 7 and 8. In general, throughout the study, the asparagus blanched in boiling water was found to contain more ascorbic acid per 100 g than that blanched in the pressure saucepan. The loss of ascorbic acid over a period of six months was not great.

In the majority of cases the largest amount of ascorbic acid was lost during the first two weeks of storage.

The data for the asparagus blanched in the pressure saucepan showed erratic results. The product tested at three months, for example, showed a greater content of ascorbic acid than that tested at two months. Such results might have been due to variations within the vegetable itself, to improper techniques or to errors in the extraction of the ascorbic acid. The amount of disintegration of the asparagus has a direct relationship to the amount of ascorbic acid extracted. Since asparagus is a fibrous vegetable, there is difficulty in blending it completely. Therefore, the amount of ascorbic acid might vary due to extraction.

The asparagus blanched in the boiling water varied less in ascorbic acid content throughout the storage period than did that blanched in the pressure saucepan.

The tables show that the amounts of ascorbic acid found in this study are in line with other previous work. Fitzgerald and Fellers (1938) report 18 to 44 mg per 100 g sample of freshly cut vegetable. Table 6 shows an average of 43.93 mg per 100 g for a similar product. The same workers found from 9 to 32 mg per 100 g of the frozen asparagus. The figures reported in this study lie largely within this range.

Blanched Asparagus. The fresh, raw asparagus, before blanching was found to have an average ascorbic acid content of 43.93 mg per 100 g sample. Similar asparagus blanched in boiling water showed a loss of 17.7 per cent ascorbic acid in comparison with 20.9 per cent for that blanched in the pressure saucepan.

Throughout the six month storage period, the results did not always show a gradually decreasing amount of ascorbic acid. At two weeks, the asparagus blanched in boiling water averaged 31.45 mg per 100 g sample and that blanched in the pressure saucepan 23.25. However at one month, the data show that asparagus blanched by either method contained more ascorbic acid than it had at the two week testing period. Some of this variation might have been due to variations in the asparagus.

From the two month to the six month period, the asparagus blanched in the boiling water decreased in ascorbic acid content from 32.52 mg to 29.14 mg per 100 g sample. The asparagus blanched in the pressure saucepan decreased in ascorbic acid content also. At the end of the final storage period, the asparagus blanched in the pressure saucepan averaged 21.92 mg ascorbic acid per sample; however, there was an increase at the three month period, Table 8.

An increase in flavor score was noted at the one month period. At that time the ascorbic acid content was also at its highest point after storage.

In general throughout the storage period, the ascorbic acid content lessened as the palatability decreased.

The asparagus blanched in the pressure saucepan was lower in both ascorbic acid and palatability than that blanched in the boiling water.

Blanched, Cooked Asparagus. Cooked asparagus which had been blanched in boiling water contained an average of 30.65 mg of ascorbic acid at the beginning of the study compared with 33.40 for that blanched in the pressure saucepan. This is the only instance in the study where the amount of ascorbic acid was higher for asparagus blanched in the pressure saucepan than for that blanched in boiling water.

Before storage, the cooked blanched asparagus had lost an average of 30.2 per cent when blanched in boiling water and 23.8 per cent when blanched in the pressure saucepan, based on the amount of ascorbic acid present in the raw vegetable. Throughout the storage period the cooked asparagus blanched in the pressure saucepan lost 30.7 per cent of its ascorbic acid and that blanched in boiling water 8.9 per cent on the same basis.

In the cooked sample, as in the blanched asparagus, the ascorbic acid did not decrease consistently. At two weeks, the asparagus blanched in the pressure saucepan averaged 20.59 mg per 100 g sample and that blanched in boiling water 28.36. Both increased at one month and decreased at the two month period so that after two months the ascorbic acid content was about the same as at two weeks. At the three month period, the asparagus blanched in the pressure saucepan again showed an increased ascorbic acid retention but that blanched in boiling water decreased. At the end of six months the cooked asparagus blanched in boiling water contained 26.53 mg ascorbic acid per 100 g sample and that blanched in the pressure saucepan 19.96.

The amount of ascorbic acid in the liquid from the cooked samples varied also. Throughout the six month period, the cooking liquid from the asparagus blanched in boiling water showed on the average a greater amount of ascorbic acid than did the cooking liquid from that blanched in the pressure saucepan. The amounts present did not decrease gradually, nor did they always bear a direct relationship to the amount of ascorbic acid in the cooked vegetable.

Throughout the tables, there are several figures which appear to be out of line. For example, one of the samples of asparagus blanched in the pressure saucepan and analyzed without further cooking after two weeks' storage showed a retention of 15.24 mg of ascorbic acid per 100 g of sample. The corresponding cooked sample was also low. These are lower than the other figures. These differences may have been due to differences in the samples or to errors in technique.

Ascorbic Acid Content of Blanched, Raw Asparagus. Series I and II. Fresh, raw asparagus before blanching averaged 41.00 mg per 100 g sample in Series I, Table 6. In Series II, similar asparagus was found to have an average of 46.86 mg per 100 g sample. This is in agreement with statements of Gleim, Tressler and Fenton (1944) who pointed out that the highest value for vitamin C was found in asparagus harvested at the end of the season. Since the time interval between series in the present study was only one week this factor may not have as direct an influence as in their study.

A study of the data did not show any definite trend in the ascorbic acid content of the asparagus blanched in either series regardless of method of blanching or type of sample, Tables 9 and 10. The asparagus blanched in the pressure saucepan averaged more ascorbic acid in Series II in 67 per cent of the cases. In Series II, the asparagus blanched in the boiling water had more ascorbic acid in only 39 per cent of the samples. The asparagus blanched in boiling water averaged more ascorbic acid in Series I in 61 per cent of the cases.

These differences may be due to the fact that the asparagus in Series I was cut and blanched one week before that in Series II.

SUMMARY

The purpose of this study was to compare asparagus blanched in the pressure saucepan with that blanched in boiling water, on the basis of palatability and ascorbic acid content.

Two series of asparagus were frozen, one each week for two weeks. Within each series, two replications were made by each method.

Peroxidase tests run on the stalks of asparagus blanched for that purpose gave negative results. Later tests on frozen samples gave positive results. This would indicate that asparagus blanched in 100 g bunches was not adequately blanched.

Fibrousness tests on the freshly blanched asparagus revealed that the product blanched in the pressure saucepan was less tender than that blanched in the boiling water.

A palatability panel scored the asparagus when fresh and after two weeks, one month, two months, three months and six months' frozen storage. At the same periods, ascorbic acid determinations were run on duplicate samples.

The ascorbic acid content of the asparagus blanched in the boiling water was, in general, higher than that of the asparagus blanched in the pressure saucepan. From a nutritional standpoint, this fact would indicate that blanching asparagus in boiling water is preferable to blanching it in the pressure saucepan.

The asparagus blanched in the boiling water maintained an acceptable flavor during a longer period of storage than the asparagus blanched in the pressure saucepan. After only two weeks of frozen storage, the asparagus blanched in the pressure saucepan was scored slightly inferior. It was not until the asparagus blanched in boiling water had been in frozen storage six months that its flavor was judged slightly inferior. This would indicate that the asparagus blanched in boiling water was more desirable.

In general, throughout the storage period, the ascorbic acid content of the asparagus lessened as the palatability decreased.

The ascorbic acid content of the asparagus cut at the earlier date and blanched in the pressure saucepan was generally lower than that cut later. The asparagus blanched in the boiling water had a higher ascorbic acid content when cut at the earlier time. These results would indicate that there was no consistent trend in this asparagus cut within a period of ten days.

The asparagus cut at an earlier date was found to be generally more acceptable to the panel of judges than that cut later. This fact held true, regardless of method of blanching used.

Because of the wide range of results, the investigator would recommend that further work be done along this line. At that time, the stalks of asparagus to be used for the peroxidase test should be enclosed in the bags with the rest of the sample. This would ensure more uniform blanching and would make the testing more valid.

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APPENDIX

SCORE CARD

Frozen Fruits and Vegetables

Date ______________

Sample No. _______

____

Name ______________

		1	2
1. Aroma	Use the following numbers as a guide for scoring: Very Superior +5 Superior +4 Moderately Sup. +3 Slightly Sup. +2 Very sl. sup. +1 Standard 0 Very sl.inferior -1 Sl. inferior -2 Moderately inf. -3 Inferior -4 Very inferior -5		
2. Appearance Color Shape Shriveled			
3. Flavor			
4. Texture			
Would you consider this as an acceptable product to serve at a meal?			
Comments:			

Table 1. Readings for shear value of asparagus.

Blanched in			
Boiling Water		Pressure Saucepan	
Series I	Series II	Series I	Series II
pounds pressure required to shear asparagus stalks			
6.0	10.5	27.0	10.0
4.5	10.0	15.0	10.0
6.0	12.0	6.5	16.0
7.5	8.5	7.0	8.5
10.5	15.5	10.5	7.0
11.0	12.5	8.0	7.0
14.0	8.0	12.0	11.5
6.0	6.0	7.0	6.0
25.0	12.0	10.0	15.0
6.0	9.0	8.0	10.5
12.0	10.5	9.5	12.0
7.0	10.0	6.0	4.0
8.5	10.5	5.5	11.0
7.5	6.5	8.5	9.5
8.0	14.0	10.5	9.5
5.5	10.0	9.5	6.0
12.5	12.0	10.0	9.5
5.5	9.0	8.0	5.0
20.0	11.0	9.0	14.0
5.0	7.0	7.0	10.5
5.5	8.5	5.0	6.5
3.5	9.0	7.0	6.0
4.0	6.0	9.0	5.5
5.0	11.0	9.0	7.0
6.0	24.5	8.0	9.0
4.0	7.0	7.0	13.5
5.0	4.5	4.0	9.0
4.5	3.5	10.0	9.0
	4.5	10.5	9.5
	7.5	8.0	9.0
	7.0	10.5	5.0
	4.5	7.0	7.5
		12.0	6.5
		6.5	7.0
		10.5	14.5
		6.0	13.0
		5.0	20.5
		17.0	19.0
		13.0	10.0
		11.5	11.5
		7.5	7.0
		4.0	6.5
		9.0	7.5
		6.0	8.5
		8.0	3.5

Table 1 (concl.)

	Blanched in			
	Boiling Water		Pressure Saucepan	
	Series I	Series II	Series I	Series II
	pounds pressure required to shear asparagus stalks			
			9.0	5.0
			8.5	6.5
			9.5	4.0
			8.5	9.0
			8.0	10.5
			8.0	11.5
				12.5
				9.5
				15.0
				6.5
				6.5
Average	7.05	9.35	8.68	9.45
Average of Series I and Series II	8.20		9.07	

Table 2. Palatability scores for fresh, cooked, unblanched asparagus. Average of two replications.

Characteristic scored	Average score
Aroma	1.7
Appearance	2.3
Flavor	1.8
Texture	1.1
Acceptable	97%

Table 3. Palatability scores for asparagus. Averages of two replications.

Blanched in	Characteristic scored	Stored for 2 wks	1 mon	2 mon	3 mon	6 mon
Boiling Water	Aroma	1.5	0.7	0.1	0.4	-2.0
	Appearance	0.8	0.8	0.2	0.5	-0.8
	Flavor	1.0	-0.3	-0.5	-0.1	-1.9
	Texture	0.7	0.4	-0.6	0.0	-1.7
	Acceptable	84%	83%	68%	58%	29%
Pressure Saucepan	Aroma	0.4	0.3	-1.3	-0.8	-1.8
	Appearance	0.9	0.3	0.4	0.5	-1.6
	Flavor	-1.7	-1.0	-3.1	-3.0	-3.3
	Texture	-0.5	-0.3	-0.4	-1.2	-1.4
	Acceptable	41%	56%	0%	13%	22%

Table 4. Palatability scores for fresh, cooked asparagus. Average of two replications.

Series	Characteristic scored	Average score
I	Aroma	2.0
	Appearance	2.7
	Flavor	2.4
	Texture	1.0
	Acceptable	97%
II	Aroma	1.7
	Appearance	2.0
	Flavor	1.7
	Texture	1.3
	Acceptable	97%

Table 5. Palatability scores for frozen, cooked asparagus. Average of two replications.

Method of blanching	Series	Characteristic scored	2 wks	1 mon	2 mon	3 mon	6 mon
Boiling Water	I	Aroma	0.9	1.0	0.0	0.9	-1.0
		Appearance	0.8	1.3	0.8	1.0	-0.4
		Flavor	1.3	0.5	0.0	0.5	-0.6
		Texture	1.0	0.8	-0.5	0.6	-0.8
		Acceptable	82%	92%	79%	59%	35%
Boiling Water	II	Aroma	0.4	0.3	0.0	0.0	-2.0
		Appearance	1.3	0.4	-0.1	0.2	-1.0
		Flavor	0.5	-0.5	-0.8	-0.4	-2.6
		Texture	0.7	-0.2	-0.6	-0.8	-1.4
		Acceptable	87%	74%	57%	58%	35%
Pressure Saucepan	I	Aroma	0.6	0.7	-0.8	-1.3	-2.1
		Appearance	1.0	2.2	0.6	0.7	-1.4
		Flavor	-1.4	-1.1	-2.9	-3.2	-3.2
		Texture	-0.2	0.9	-0.4	-2.3	-1.4
		Acceptable	50%	76%	0%	12%	25%
Pressure Saucepan	II	Aroma	-0.1	0.4	-2.3	-1.0	-1.2
		Appearance	1.0	0.0	0.6	0.5	-1.5
		Flavor	-1.8	-1.7	-3.7	-3.0	-2.2
		Texture	-0.4	0.8	-0.7	-2.2	-1.0
		Acceptable	32%	35%	0%	14%	19%

Table 6. Ascorbic acid content of raw asparagus.

Series	Mg ascorbic acid per 100 g sample
I	42.88
	44.99
	35.14
Average	41.00
II	43.78
	47.81
	49.00
Average	46.86
Average of I and II	43.93

Table 7. Ascorbic acid content of asparagus blanched in boiling water.

Mg ascorbic acid in 100 g sample	Fresh	After storage of 2 wks	1 mon	2 mon	3 mon	6 mon
Blanched	39.70	32.38	35.39	34.93	32.85	28.47
	35.33	32.00	35.42	37.68	31.54	29.84
	37.82	31.54	35.04	30.14	32.37	29.50
	38.90	28.88	30.42	27.32	32.37	28.76
Average	36.14	31.45	34.07	32.52	32.28	29.14
Blanched, Cooked	27.77	27.37	33.06	33.61	24.07	26.48
	32.05	--	32.34	27.32	29.05	26.86
	30.96	31.63	30.42	28.26	29.24	27.12
	31.70	25.08	30.42	27.32	29.88	26.75
Average	30.65	28.36	31.56	29.13	28.06	26.53
Cooking Liquid	.556	.719	.994	.348	.467	.418
	.501	.792	.878	.509	.365	.433
	.310	.448	.546	.378	.632	.442
	.222	.543	.402	.603	.599	.448
Average	.340	.626	.705	.460	.515	.435

Table 8. Ascorbic acid content of asparagus blanched in the pressure saucepan.

Mg ascorbic acid in 100 g sample	Fresh	After storage of 2 wks	1 mon	2 mon	3 mon	6 mon
Blanched	37.72	21.72	31.18	26.38	33.20	22.04
	37.72	15.24	30.80	23.55	24.07	19.40
	28.78	24.14	33.69	22.61	32.28	22.16
	--	31.92	28.86	24.48	29.88	24.07
Average	34.74	23.25	31.13	24.25	29.86	21.92
Blanched, Cooked	27.40	22.86	28.54	21.19	29.47	19.40
	--	11.43	27.72	21.67	19.92	18.65
	35.68	24.14	28.89	18.84	29.78	22.33
	37.32	23.94	24.96	20.72	26.54	22.33
Average	33.40	20.59	27.53	20.61	26.43	19.96
Cooking Liquid	.504	.366	.570	.550	.581	.442
	.501	.351	.801	.546	.448	.373
	.576	.397	.547	.546	.581	.367
	.254	.510	.273	.565	.531	.537
Average	.489	.406	.523	.552	.535	.430

Table 9. Ascorbic acid content of asparagus blanched in boiling water. Average of three replications.

Mg ascorbic acid: per 100 g sample	Series	Fresh	After storage of 2 wks	1 mon	2 mon	3 mon	6 mon
Blanched	I	37.52	32.19	35.41	36.31	32.20	29.15
	II	38.36	30.21	32.73	28.73	32.37	29.13
Blanched, cooked	I	29.91	28.37	32.70	30.47	26.56	26.67
	II	31.33	28.36	30.42	27.79	28.56	26.82
Cooking Liquid	I	.528	.756	.936	.429	.416	.445
	II	.226	.496	.474	.490	.616	.445

Table 10. Ascorbic acid content of asparagus blanched in the pressure saucepan. Average of three replications.

Mg ascorbic acid: per 100 g sample	Series	Fresh	After storage of 2 wks	1 mon	2 mon	3 mon	6 mon
Blanched	I	37.72	18.48	30.99	24.96	28.64	20.72
	II	28.79	28.03	31.28	23.54	31.08	23.11
Blanched, cooked	I	27.40	17.14	28.13	21.43	24.70	19.02
	II	36.49	24.04	26.98	19.78	28.16	20.90
Cooking Liquid	I	.502	.359	.685	.548	.515	.408
	II	.430	.454	.420	.556	.556	.452

THE PALATABILITY AND ASCORBIC ACID CONTENT OF ASPARAGUS BLANCHED IN THE PRESSURE SAUCEPAN VERSUS THAT BLANCHED IN BOILING WATER

by

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Abstract of Thesis

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INTRODUCTION

Homemakers have questioned the advisability of blanching vegetables in the pressure saucepan preparatory to freezing. Therefore, this study was made to compare frozen asparagus blanched in boiling water and in the pressure saucepan on the basis of palatability and ascorbic acid content.

EXPERIMENTAL PROCEDURE

Asparagus was prepared in two series one week apart. Two methods of blanching were used - boiling water and the pressure saucepan. Fibrousness tests were done on the blanched stalks to determine the tenderness of the asparagus. Peroxidase tests were also run to determine the adequacy of blanching by each method. The asparagus to be frozen was packaged in pliofilm and stored for varying periods up to six months. The fresh asparagus was tested immediately.

At stated periods, samples were removed from the locker for palatability tests. Ascorbic acid determinations were also run on the blanched asparagus, cooked asparagus and on the cooking liquid. A modification of the Loeffler-Ponting method was used for all ascorbic acid determinations. The amount of ascorbic acid present was calculated in mg per 100 g sample.

DISCUSSION OF RESULTS

Fibrousness tests on the freshly blanched asparagus revealed that the product blanched in the pressure saucepan was less tender than that blanched in the boiling water.

Peroxidase tests done on the stalks of asparagus blanched for that purpose gave negative results. Later tests on frozen samples gave positive results. This would indicate that the asparagus blanched in 100 g bunches was not adequately blanched.

The asparagus blanched in the boiling water maintained an acceptable flavor during a longer period than that blanched in the pressure saucepan. The ascorbic acid content of the asparagus blanched in the boiling water was, in general, higher than that of the asparagus blanched in the pressure saucepan. From a nutritional standpoint, this fact would indicate that blanching asparagus in boiling water is preferable to blanching it in the pressure saucepan.

In general, throughout the storage period, the ascorbic acid content of the asparagus lessened as the palatability decreased. No consistent trend was noted in the results of the ascorbic acid content of asparagus cut at the earlier and the later dates. That cut earlier was, however, more acceptable to the panel of judges than that cut later, regardless of blanching method.

CONCLUSIONS

A study of the data from this experiment would indicate that asparagus blanched in the pressure saucepan is inferior to asparagus blanched in boiling water both in ascorbic acid content and palatability. Because of the wide range of results, the investigator would recommend that further work be done on this problem. She would also suggest that the stalks of asparagus to be used for the peroxidase test should be enclosed in the bags with the rest of the sample. This would ensure more uniform blanching and would make the testing more valid.