EVALUATION OF THE QUALITY OF PACKAGED FROZEN PEAS

by

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I. INTRODUCTION

Frozen peas have been recognized as an important food item in previous years. The following statistical figures show the rapid growth of the industry in this country.

U. S. Frozen Peas Packs by Years (42)
(Thousands of Pounds)

1934-35	2,875
1936-40	29,299
1941-45	73,771
1946	140,603
1947	131,786

In the retail outlets, frozen peas are found along with frozen orange juice concentrates in the display freezers. The recent demand for frozen orange juice has provided a "carry-over" into other frozen food products, including peas. Consequently, it is very important to have frozen peas of excellent quality in the retail outlets if "repeat" sales are going to be made.

There are many factors influencing the yield and quality of frozen peas. Maturity is the most important among them because it relates to color, flavor and texture of the product. As Pollard <u>et al</u> (39) have stated "Both growers and processors are definitely interested in knowing the stage of maturity at which peas should be harvested for the greatest yield of acceptable quality. Peas harvested and processed at that stage should give both growers and canners the maximum return if grading methods are satisfactory and price schedules equitable." This statement is just as true for peas harvested for freezing.

The problem of the present investigation was suggested by the student's major advisor for the following reasons:

1. During the summer of 1948, eight plants freezing peas in the Northwest were visited. With a single exception, these operators were freezing peas of rather poor quality. In most cases, the peas were definitely overmature.

2. The need for the development of quality tests on frozen pack peas and other vegetables was stressed recently by Campbell (7).

3. As a very popular vegetable, frozen peas are enjoyed for their inherent sweetness, that is before they become overmature and starchy.

Consequently, the development of a quality control test which would determine the quality of frozen pack peas would be of considerable value to a company. It would enable a company to compare the quality of their pack with that of their competitors and so enable a company to know where to set the price of their product in relation to that of their competitors. Necessity for this type of information has been shown in a recent survey report by

Sherman _et al_ (41) who found that, in many cases, the lower priced samples of frozen peas were superior to the higher priced samples.

The importance of sweetness for green peas was brought out by Cruess (12) who advocated the practice of adding sugar to frozen peas just before cooking. This practice seems foolish in as much as the addition of sugar in no way eliminates the excess starch found in a good many samples of frozen peas. It would appear that the proper approach to this problem should be the harvesting of the peas at the proper stage of maturity. Also the introduction of newer varieties should play an important part. It was felt that, sooner or later, the experiment station would start on such a testing program.

With these thoughts in mind, it was felt that a critical survey of the research up to present time as well as preliminary experiments on a quality control test would be of considerable value to the frozen food industry where frozen peas constitute the second largest item. The primary object of this investigation was twofold, namely,

1. A critical survey of the previous work done in the field with particular reference to research done in the Northwest.

2. The development of a quality test for frozen peas. This test should be quick, easy to carry to completion and

it should be an objective test.

With these objects in mind, preliminary work has been initiated on this problem.

II. LITERATURE REVIEW

1. Maturity Tests for Frozen Peas.

Among the numerous factors that affect the quality of frozen peas, maturity requires careful consideration because of its relationship to color, flavor, and texture. Martin and co-workers (35), and Walls and Kemp (51) have reported a high degree of correlation between the maturity of peas and their tenderometer readings. Due to the fact that the tenderometer can not be used for packaged frozen peas, other methods have been developed for the determination of the maturity of the frozen product.

The common criterium of maturity, now used, is alcohol-insoluble solids content. Kertesz (25), Bonney (6), Strasburger (44), Biegelow (3), Walls and Kemp (51) and Kramer (29) have shown that a close correlation between maturity and alcohol-insoluble solids exists. The factor of maturity is measured officially by the percentage of alcohol-insoluble solids (1). For example in the following table, we have tabulated some of Kramer's results to illustrate this correlation for the Thomas Laxton variety of peas.

TABLE I

RELATION BETWEEN MATURITY AND ALCOHOL-INSOLUBLE SOLIDS VALUE

Tenderometer readings	Alcohol-insoluble solids Canned	Alcohol-insoluble solids Raw
75	6.0	8.0
80	8.7	9.8
85	9.7	10.8
90	10.5	11.8
95	11.1	12.8
100	11.7	17.8
105	12.3	14.7
110	12.9	15.6

Various investigators have noted that as peas increase in maturity, both the solids content and starch content increase. This relationship has been suggested as a basis for an index of maturity. Pyke (40) and Nielson _et al_ (38) have found a close correlation between the starch and total solid contents of frozen peas and the tenderometer reading of the raw products. Strasburger (45) has claimed that the solid tests were good indicators of quality in canned fresh peas. Pollard and co-workers (39) have found that the starch content increased as the peas advanced in maturity. The increase was proportional to the increase in tenderometer readings.

Sugar content of the frozen peas is regarded as important because of its influence on flavor. Some investigators have used the sugar content as an index of maturity of peas. Jodidi (19,20) has found that young, unripe peas contained high sugar and low starch, and old peas contained low sugar and high starch. The sugar/starch ratio has been suggested to be an index of the quality of peas. Blanchard and Maxwell (4) have reported that the sugar content and the subjective score of frozen peas were related equally to the maturity.

Jodidi (19,20) has found that the specific gravity could be used as an index of the maturity of peas. Lee (31) has determined the specific gravity of thawed peas by means of the difference between the weight of the sample in air and in a mixture of xylene and carbon tetrachloride which has a specific gravity of exactly one. This method has been reported to be more rapid than the determination of alcohol-insoluble solids and the correlation with organoleptic tests was nearly the same for both methods.

Since peas rank high in protein content among the vegetables commonly used, some investigators have attempted to use the protein content as an index of the quality. Nielsen et al (38) have reported that the protein content increases in a curvilinear manner with increase in maturity. Also Kramer (28) has found a highly significant positive correlation between the protein content and the degree of maturity of peas.

2. Ascorbic Acid Content of Frozen Peas.

The ascorbic acid contents of fresh peas have been summarized by Todhunter and Robbins (46). The majority of the reported values range from 0.24 to 0.35 mg. per gram of peas on the wet basis. Factors which affect the ascorbic acid content are the maturity and size of the peas (33,39,47), the variety (47), and the time elapsing between harvesting and analysis. Vitamin C content of fresh peas of any variety gradually decreased with increased maturity. Peas of small sieve grades contained more ascorbic acid than larger peas. Fellers and Stepat (16) reported a loss of 51.5 percent of ascorbic acid from fresh-picked peas which were stored and then analyzed 24 to 48 hours later; the raw freshly picked immature peas showed a mean value of 0.345 mg. of ascorbic acid per gram and 0.147 mg. after one to two days. Mack et al (33) reported a similar destruction of ascorbic acid of peas in the pod held in storage at room temperature.

Jenkins, Tressler and Fitzgerald (18) observed that peas lost approximately 30 percent of their original content of ascorbic acid during commercial preparation for quick freezing. Fenton and Tressler (17) found a loss of about 38 percent under these conditions. Jenkins et al (18) reported that the loss due to blanching alone was about 10 percent. According to Lee and Whitecombe (32), the loss of ascorbic acid in peas during blanching ranged from 10 to 19 percent of the original amount of ascorbic acid. Van Duyne and co-workers (49) reported that the peas retained 85 percent of their original ascorbic acid content after blanching.

Wagner et al (50) and Moyer et al (37) showed the high temperature, short time blanching permitted a better retention of ascorbic acid in peas. Todhunter and Robbins (46) reported that steam blanching is preferable to hot water in retaining the ascorbic acid. Blanching in hot water for one minute caused a loss of about 35 percent of the ascorbic acid in peas. The loss of vitamin C during the blanching of peas was due to the leaching action of hot water and to destruction by enzymes when the heat was insufficient to inactivate the ascorbic acid oxidase (37).

After quick freezing, Todhunter and Robbins (46) did not observe any further significant loss of ascorbic acid from peas that were held in freezer locker storage at 0°F. for 11 months. Jenkins et al (18) studied the effect of storing frozen vegetables at 0°F.; peas did not lose any appreciable amount of ascorbic acid. However, according to Van Duyne et al (49), a higher percentage of ascorbic acid was lost from peas during freezer locker storage at 0°F.

Tressler (48) has suggested that ascorbic acid content may be used as the index of the quality of frozen peas. The exact correlation between the ascorbic acid content and the quality has not been definitely shown. It seems reasonable to use the ascorbic acid content as a criterion of the general quality of the product. If frozen peas have a relatively high content of ascorbic acid, it indicates that peas of the proper maturity were carefully handled throughout the process of preparation for freezing and that they have been maintained in frozen storage under satisfactory conditions.

Kramer (30) used the iodine-reducing value as an index of the quality of frozen lima beans. He also suggested that this method could be applied to determine the quality of frozen peas. As the iodine-reducing value is related to vitamin C content, it seems a simple and rapid method to be used for determining the quality of frozen peas if it could be applied satisfactorially.

3. Blanching of Peas for Freezing.

All living tissues contain enzymes. The rate of enzyme action is greatly reduced by refrigeration. However, even at 0°F., enzyme action is still sufficiently rapid to change the flavor of unblanched vegetables in a few weeks (48). It is essential that the vegetables should be treated by heat to inactivate enzymes. If the scalding treatment has not been sufficient to inactivate the enzymes, the frozen peas will develop off-flavors during zero storage (13,14).

Respiratory activity in the tissues of peas causes deterioration of the shelled green peas. Kertesz and Green (27) have reported that the percentage and absolute amount of total sugars in unblanched chilled peas decrease during a few days prior to canning.

It is well known that acetaldehyde is formed in appreciable amounts during anaerobic respiration. Joslyn and co-workers (22) have reported that the acetaldehyde in frozen peas decreased with increase in time of blanching. It has been suggested that acetaldehyde could serve as an index of respiratory activity. Tressler (48) has suggested that enzyme activity could serve as a criteria of quality in frozen vegetables. Simple methods of making a qualitative test for catalase and peroxidase have been developed (2,21,36). The color is developed by the action of the enzymes in the presence of guaiacol and hydrogen peroxide. These tests are of great help in determining proper blanching time for frozen vegetables.

Kertesz and co-workers (26) have reported that ascorbic acid oxidase in peas is completely inactivated in one minute at 100°C. Ascorbic acid oxidase and catalase are inactivated by heat at the same rate (26). The losses of high amount of ascorbic acid from fresh-picked peas which were held for one to two days were reported (14,33). Wagner et al (50) reported that a high temperature, short time blanching permitted a better retention of nutrients in peas.

The blanching operation should be sufficient to inactivate the enzymes present in the fresh peas. Over blanching would cause a mushy texture. Many workers have reported the proper blanching conditions for peas for freezing. In table II, we have tabulated some of the reported blanching conditions.

TABLE II

BLANCHING CONDITIONS FOR PEAS FOR FREEZING

Variety	Treatment	Temperature °C	Time in seconds	Reference
Tall Alderman	Hot water	100	60	(46)
Tall Alderman	Steam	100	60	(46)
Thomas Laxton	Hot water	90	60	(49)
Thomas Laxton	Hot water	100	60	(32)
Unstated	Hot water	100	60	(37)
Alderman' Tel.	Hot water	100	40	(18)
Alderman' Tel.	Steam	100	60	(18)
Alderman' Tel.	Hot water	85	120	(22)
Unstated	Hot water	100	60	(26)

4. Color and Texture of Frozen Peas.

In addition to enzyme inactivation, blanching is necessary to bring out the bright green color found in frozen peas of good quality. The relation between enzyme activity and development of certain undesirable factors has been studied by many workers. Joslyn and Marsh (24) and Diehl *et al* (15) found that blanching or scalding resulted not only in greener appearing vegetables, but also in lessening to a marked degree the yellowish-brown discoloration on subsequent cooking so noticeable with inadequately blanched samples. It has been reported that microorganisms destroy the green color by acid production if the freezing of peas is delayed (15,8).

Campbell (8) has found that too high a storage temperature favored discoloration owing to a progressive conversion of chlorophyll to pheophytin, even though the vegetables were apparently adequately scalded. Determined by the spectroscope and by the saponification products, Mackinney (34) found that much of the chlorophyll in frozen peas changed to pheophytin. It has also been reported that blanching reduced the amount of green color loss by removing air, volatile and water-soluble constituents which would react with the chlorophyll (34).

Candee and Boggs (11) have deviced an instrument to measure the texture of cooked peas. The resistance of the skins of cooked peas to penetration and of the cotyledons to crushing is used as a measure of the texture. Higher penetration and crushing values denote tougher structure. Many factors have been found to influence the texture of peas preserved by freezing by Campbell and co-workers (9,10). The longer that the peas were left in the field, the greater was the penetration value for a given size of cooked frozen peas. Vining toughened both the skins and cotyledons of frozen peas. The cotyledons of frozen peas were tougher than those of the fresh peas but no difference in skin texture was found. Delay between vining and freezing toughened the skins but not the cotyledons of frozen peas. The skins of the frozen peas held for more than 24 hours in storage were considerably tougher than those held for only 24 hours. The results for the crushing value of cotyledons held for these periods were found to be inconsistent. If the peas, following thawing, were refrozen and stored for two weeks, the skins were seriously toughened. Bruising of the peas, was found to toughen the skins of the frozen peas.

5. Varieties of Peas Suitable for Freezing.

Certain varieties of peas are suitable for freezing and certain varieties are suitable for canning. Peas suitable for freezing must be tender and sweet at prime maturity. When blanched, they must turn to a brilliant green color. Both skin and cotyledon texture should be tender. The flavor and general quality should be good.

Wilcox and Morrell (54) have reported that varieties of Atlas, Wyola, Wando and Improved Stratagem were suitable for freezing in Utah. Weigand et al (53), taking into consideration both quality and cultural factors, rated the following varieties as best in the Pacific Northwest for frozen pack use: World's Records, Improved Gradus, Thomas Laxton, Asgrow 40, Onward, Roger 95, Stratagem, and Tall Alderman.

A check of plants in the Northwest during the summer of 1948 showed that the following varieties were used for freezing: Alderman, Thomas Laxton, Gradus, Improved Gradus, Dark Green Perfection, Tall Alderman and Wyola. The Wyola variety had superior flavor and tenderness.

III. EXPERIMENTAL PROCEDURES

1. Source and Variety of Peas.

Thomas Laxton peas were from a local garden and were picked at different times before the peas became over-mature. The peas were picked before 8 A. M. and transferred to the 34°F. room at once for analyzing and processing on the same day that they were picked. The market peas were obtained from the local wholesale fruit and vegetable company. Peas in some of the local retail markets presumably came from this wholesale house and consequently we received these samples at the same time or before the local stores.

Five different brands of commercial frozen peas, which were packed in 1948 season and stored in 0°F. freezer, were obtained from the Agriculture Experimental Station of Oregon State. The 1949 commercial frozen samples were bought from local grocery stores.

2. Processing Procedures.

The peas were podded by hand and mixed thoroughly. The moisture content, ascorbic acid content and iodine-reducing value were determined. Portions of 500 grams of peas were blanched in steam for one minute and in boiling water for one and two minutes separately. One gallon of water was used for each 500 grams of peas treated. After blanching, the peas were cooled for one minute in a volume of water equal to that used for blanching. The peas were drained on screens for two minutes and then weighed. The moisture content, ascorbic acid content and iodine-reducing value of the blanched peas were determined. The losses of solids, ascorbic acid content and iodine-reducing value of the peas due to blanching were investigated.

Right after the blanching and cooling treatment, the peas were packaged in cellophane liners placed in cartons. As much air as possible was forced out of the cellophane liners and the cellophane liner was heat-sealed with the hand sealer. Approximately 10 ounces of peas were placed in each container. The cartons were placed in a quick freezer (-20°F.) for six hours, then stored in the storage room (0°F.). The frozen peas were analyzed for ascorbic acid at the end of one, three, and five months.

3. Analytical Determinations.

(1). Determination of Ascorbic Acid. The titration method, based on that described by A. O. A. C. (1), was used in determining the ascorbic acid content in peas. The ascorbic acid content in the peas was calculated as the number of milligrams of ascorbic acid in 100 grams of the sample.

Ten grams of peas were ground in a glass mortar with 20 ml. of acid solution containing eight percent acetic acid and three percent metaphosphoric acid. The acid extract was then strained through cheesecloth of double thickness. The residue was washed with 20 ml. of the acid solution. The extract was then centrifuged three minutes, and the clear liquid decanted into a 50 ml. volumetric flask. Then the total volume of the extract was made to 50 ml. with the acid solution. Aliquots of 20 ml. were quickly titrated with 2,6-dichlorobenzenone-indophenol solution until a faint pink color was observed which lasted for five seconds. The end-point in this procedure was sharp.

The 2,6-dichlorobenzenone-indophenol solution was prepared by dissolving 0.05 gram of reagent-grade dye, which had been stored in desiccator over soda lime, in 50 ml. of distilled water to which had been added 42 mg. of sodium bicarbonate. When the dye had dissolved, the solution was diluted to 200 ml. with water. It was filtered through a fluted filter into a glass-stoppered bottle. The solution was stored in refrigerator and was standardized with pure l-ascorbic acid.

(2). <u>Determination of Iodine-Reducing Value.</u> The iodine-reducing value was first suggested by Joslyn and co-workers (23) for the measurement of vitamin C in vegetables. It was also employed to determine the ascorbic acid content of apple juice fortified with ascorbic acid (43). Kramer (30) designated it the iodine-threshold value, and modified it to measure the quality of lima beans.

Ten-gram samples of peas were ground in a glass-mortar with 25 ml. of a solution containing two percent metaphosphoric acid and eight percent sulfuric acid. The acid extract was then strained through cheesecloth of double thickness. The residue was first washed with 15 ml. of metaphosphoric acid solution, then washed with 20 ml. of eight percent sulfuric acid solution. The filtrate was centrifuged for three minutes and the clear liquid was titrated with 0.01 N iodine solution until the first appearance of blue color. Two ml. of one percent starch solution was used as indicator. It should be noted that the iodine-reducing value is taken as the number of ml. of 0.01 N iodine solution used in the titration of a 10 gram sample of peas.

(3). <u>Determination of Moisture</u>. The moisture content of peas was determined by a modification of A. O. A.C. method (1).

A representative sample of peas was ground and mixed thoroughly in a glass-mortar. The operation was completed as quick as possible to avoid loss of moisture. Approximately ten gram portions of ground peas were accurately weighed and placed in weighed aluminum dishes containing a little dry asbestoes fiber. The sample was distributed thinly in an even layer over the bottom of the dish by diluting with water and then dried at 70°C under a reduced pressure not to exceed 100 mm. of Hg until consecutive weighings made at intervals of two hours did not vary more than three milligrams.

(4). <u>Test for Enzymatic Activity</u>. Enzyme activity was determined by the guaiacol colorimetric method suggested by Bedford (2). Peas were placed in a clean test tube and ten ml. of water were added. The peas were macerated with a glass rod. Then one ml. of 0.5 percent guaiacol solution (0.5% guaiacol in 50% alcohol) and 0.7 ml. of 0.5 percent hydrogen peroxide were added to the mixture of macerated peas and water. The appearance of a brownish color show the presence of active peroxidases.

4. Taste Test Procedures.

The cooking method of Boggs (5) was modified in this test. Stainless steel pans were used in the cooking. The frozen peas were placed in the pan containing boiling water. 60 ml. of water were used for each 12 ounces of frozen peas. The peas were cooked in boiling water for six minutes from the time the water boiled after the peas had been added.

The taste test procedure was based on the one recommended by Wiegand and Lorant (52). The cooked samples were graded on a score-ballot stressing flavor and general acceptability of the peas. There were four samples used for each test and one of these four samples was a duplicate. This method was used to check the accuracy of the tasters. In each subsequent test, a reference sample was included in order to relate the present test to previous tests. Those scores showing a difference on the duplicates of more than 20 percent were eliminated. The final score given each sample was the average of all scores on the panels who were not eliminated by the duplicates.

IV. RESULTS AND DISCUSSION

The effect of blanching on the moisture content and the loss of soluble solids of peas were tabulated in Tables III and IV. No appreciable change of moisture content was found before and after blanching. The loss of total solids due to blanching ranged from 2.7 percent to 8 percent. Steam blanching caused smaller losses than water blanching. Thomas Laxton peas lost eight percent of the total solids because of the tenderness of the texture.

TABLE III

EFFECT OF BLANCHING ON THE MOISTURE CONTENT OF PEAS

Variety	Method of Blanching	Moisture Content	
		Before Blanch.	After Blanch.
Market peas	1 min. 100°C water	75.75%	75.38%
Market peas	2 min. 100°C water	75.75%	75.23%
Market peas	1 min. 100°C steam	75.65%	74.78%
Thomas Laxton	1 min. 100°C water	77.15%	76.75%

TABLE IV

LOSS OF SOLUBLE SOLIDS FROM PEAS DURING THE BLANCHING PROCESS

Variety	Method of Blanching	Weight in Grams Before	Weight in Grams After	Loss % of Solids
Market peas	1 min. 100°C water	500	473	4.0%
Market peas	2 min. 100°C water	500	471	4.1%
Market peas	1 min. 100°C steam	500	480	2.7%
Thomas Laxton	1 min. 100°C water	500	458	8.0%

*Note - calculated on the basis of same moisture content.

The effect of blanching on the retention of the iodine-reducing value of peas are shown in Table V. Thomas Laxton peas lost 40.8 percent of its iodine-reducing value after blanching in 100°C. water for 1 minute. The market peas lost 6.7 to 12.3 percent. Steam blanching caused less loss of the iodine-reducing value.

Results tabulated in Tables V, VI and VII are for the same samples as in Tables III and IV and are listed in the same order.

TABLE V

EFFECT OF BLANCHING ON THE IODINE-REDUCING VALUE OF PEAS

Sample	Method of Blanching	Iodine-Reducing Value			Loss %
		Before	After	After Blanch. Calculated to Unblanch. wt.	
1	1 min. 100°C water	3.50	3.30	3.15	10.0%
2	2 min. 100°C water	3.50	3.12	2.97	12.3%
3	1 min. 100°C steam	3.40	3.30	3.17	6.7%
4	1 min. 100°C water	5.10	3.30	3.02	40.8%

In Table VI the losses of ascorbic acid of peas in the blanching process were tabulated.

TABLE VI

EFFECT OF BLANCHING ON THE ASCORBIC ACID CONTENT OF PEAS

Sample	Method of Blanching	Ascorbic Acid Content			Loss %
		Before	After	After Blanch. Calculated to Unblanch. wt.	
1	1 min. 100°C water	19.31	18.23	17.42	9.8%
2	2 min. 100°C water	19.31	16.78	15.96	12.2%
3	1 min. 100°C steam	18.90	18.76	18.01	4.7%
4	1 min. 100°C water	28.79	20.39	18.66	35.2%

It has been shown that Thomas Laxton peas lost 35.2 percent of its ascorbic acid content after blanching in 100°C. water for one minute. This was in general agreement with the results of Todhunter and Rubbins (46) who reported that blanching in hot water for one minute caused a loss of about 35 percent of the ascorbic acid in peas. Jenkins et al (18) found that during commercial preparation for freezing, there was a loss of 30 percent of the total ascorbic acid present in peas. Fenton and Tressler (17) reported a loss of about 38 percent under these conditions. The market peas lost 4.7 to 12.2 percent of the ascorbic acid after blanching. According to Lee and Whitecombe (32), the loss of ascorbic acid in peas during blanching ranged from 10 to 19 percent. However, the loss of ascorbic acid of peas by blanching depended on the texture of the peas and the method of blanching. Steam blanching caused smaller losses of the ascorbic acid in the peas. The texture of the peas was closely related to the retention of ascorbic acid. The tender peas lost more ascorbic acid by extraction than the mature peas.

The loss of ascorbic acid during storage at 0°F. was summarized in Table VII. After five months of storage, the blanched peas lost six to ten percent of their ascorbic acid content. Todhunter and Robbins (46) and Jenkins et al (15) did not observe any significant loss of ascorbic acid from peas during zero storage. Van Duyne et al (49) reported a loss of 11, 22, and 33 percent of the ascorbic acid of the peas after 3, 6, and 9 months of freezer storage at 0°F.

TABLE VII

CHANGE OF ASCORBIC ACID CONTENT OF PEAS DURING STORAGE AT 0°F.

Sample	Method of Blanching	Ascorbic Acid Content			
		Initial	1 Month	3 Months	5 Months
1	1 min. 100°C water	18.23	18.10	16.88	16.88
2	2 min. 100°C water	16.78	16.55	16.20	15.66
3	1 min. 100°C steam	18.76	18.36	18.10	17.68
4	1 min. 100°C water	20.39	20.10	19.47	18.36

The moisture content, enzyme activity, ascorbic acid content and iodine-reducing value of commercially frozen peas were summarized in Table VIII.

TABLE VIII

MOISTURE CONTENT, ENZYME ACTIVITY, ASCORBIC ACID CONTENT, AND IODINE-REDUCING VALUE OF COMMERCIALLY FROZEN PEAS

Commercial Sample	Moisture Content	Enzyme Activity	Vitamin C Content	I_2-Reducing Value	Remarks
Plant MK	78.88%	-	11.07	1.58	1948 Pack
Plant WP	76.48%	-	8.10	1.40	1948 Pack
Plant SL	78.61%	-	14.85	2.55	1948 Pack
Plant SC	80.68%	-	6.75	1.20	1948 Pack
Plant BE	80.28%	-	13.77	2.00	1949 Pack
Plant PS	80.87%	-	8.90	1.55	1948 Pack
Plant PS	78.21%	-	14.17	2.25	1949 Pack
Plant PRP	79.20%	-	19.71	2.90	1949 Pack

The ascorbic acid contents of 1949 packed frozen samples ranged from 13.77 to 19.71 mg./100 grams, and the iodine-reducing values from 2.00 to 2.90 ml. of 0.01N I_2/10 grams. The ascorbic acid contents of 1948 packed frozen samples ranged from 6.75 to 14.85 mg./100 grams, and the iodine-reducing values from 1.20 to 2.55 ml. of 0.01 N iodine solution for a ten gram sample of peas. The storage life of the 1948 packed samples was about 16 months and that of the 1949 packed samples was about five months. There was no evidence to show whether the variation in ascorbic acid content and iodine-reducing value was due to differences in methods used by packing plants, or whether it was a varietal difference of the peas themselves. However, the ascorbic acid contents of the samples from the 1948 pack were generally lower than those from the 1949 pack. It seemed that with the longer storage period there was a smaller retention of ascorbic acid in the frozen peas. Among the 1948 samples, sample from plant SL was packed in cellophane liner and had the highest vitamin C content. It would appear that a better packing method caused better retention of the ascorbic acid during the period of storage.

The organoleptic test scores of the samples of frozen peas were summarized in Table IX.

TABLE IX

ORGANOLEPTIC TEST SCORES FOR THE SAMPLES OF FROZEN PEAS

Frozen Samples	A.A.C./I.R.V. ratio	Score: Acceptability	Score: Flavor
Thomas Laxton	7.06	8	8
		9	9
		9	9
		7	6
		9	9
		7	7
		8	8
		8	8
		10	10
		9	9
		7	7
Plant BE	6.88	9.5	9.5
		6	8
		7	7
		6	7
		7	7
		7	8
		8	7
		8	8
		8	8
		7.5	7.5
		6.5	6.5
Plant FRP	6.80	7	8.5
		8	8
		7	8
		6.5	7
		7.5	7
		8	7.5
		7.5	8
		7	6
		7.5	8
Plant PS	6.3	8.5	8.5
		6	6
		5	4
		6	6
		6	5
		1	2
		5	5

TABLE IX

(CONTINUED)

Market peas (Steam blanched 1 min.)	5.89	4 4 6 2 2 5 2 4 5 5 4	4 4 5 4 2 3 2 4 5 5 4
Market peas (Water blanched 1 min.)	5.62	5 4 2 4 4 1 2	5 4 2 4 4 1 2
Market peas (Water blanched 2 min.)	5.53	4 5 4 3 3 5 1 2 2	4 5 4 3 3 5 1 2 2

The relation of ascorbic acid content and iodine-reducing value of frozen peas to its edible quality is shown in Table X.

TABLE X

COMPARISON OF CHEMICAL TESTS AND TASTE TESTS FOR FROZEN PEAS

Samples of Frozen Peas	Vitamin C Content	I_2-Reducing Value	A.A.C.* I.R.V.	Average Scores Flavor	Average Scores Acceptability
Thomas Laxton	18.36	2.60	7.06	8.2	8.3
Plant BE	13.77	2.00	6.88	7.5	7.3
Plant FRP	19.71	2.90	6.80	7.6	7.4
Plant PS	14.17	2.25	6.30	5.4	5.2
Market Peas	17.68	3.00	5.89	4.2	4.0
Market Peas	16.88	3.00	5.62	3.1	3.1
Market Peas	15.66	2.80	5.53	3.9	3.2

*Note - The A.A.C./I.R.V. ratio indicates the ratio between the ascorbic acid content and the iodine-reducing value of the frozen peas.

All these samples tested were negative in enzymatic activity. It was apparent that the qualitative test of enzymatic activity was unsuitable as a quality index for frozen peas. As shown in Table X, neither ascorbic acid nor iodine-reducing value alone was found to be related to the organoleptic tests. The peas of prime maturity (Thomas Laxton variety) lost more ascorbic acid by leaching in the pre-freezing procedures. However, because their final vitamin C content was high and the iodine-reducing value was intermediate, the ratio of these two values was the highest for these peas. The taste panel also gave the highest rating to these peas for flavor and general acceptability. Consequently it seems that the A.A.C./I.R.V. ratio could be used for checking the general quality of frozen peas. It should be noted that the mature peas (really overmature) had a lower A.A.C./I.R.V. ratio than the tender peas because the mature peas had a relatively higher iodine-reducing value than the tender peas (See Table X).

In the iodine-reducing value titration, a more turbid extract was obtained. This interfered with the titration. It was reported by Strassburger (45) that the turbidity of the liquid of canned peas was due to the presence of mature peas. As the peas increased in maturity, the starch and protein contents of peas also increased (38,40). The turbid extracts absorbed a part of the iodine and consequently increased the iodine-reducing value. The more mature the peas were, the higher the iodine-reducing value was for peas with the same level of ascorbic acid. Tressler (48) has suggested the vitamin C content as an index of the quality of frozen peas. From the results of this investigation, it would appear that vitamin C content was not suitable for the general index to measure the quality of frozen peas.

The relationship between the organoleptic test and the A.A.C./I.R.V. ratio has been determined by the use of correlation coefficient. The correlation coefficient between the A.A.C./I.R.V. ratio and the general acceptability was found to be 0.706. Therefore, it would appear that the A.A.C./I.R.V. ratio might be suitable as a measure of the quality of frozen peas. It might be possible for a frozen food packer to measure the quality of his frozen pack peas in relation to that of other processers by determining the A.A.C./I.R.V. ratio for his frozen peas and this ratio for those of his competitors. The higher the value of this ratio, would mean the better the quality of the frozen peas.

Among the samples of frozen peas tested, Thomas Laxton peas had the highest A.A.C./I.R.V. ratio and also the highest organoleptic test score. This variety of peas has proved to be suitable for freezing.

In Table XI we have tabulated the A.A.C./I.R.V. ratios for some commercial samples of frozen peas.

TABLE XI

COMPARISON OF QUALITY INDEX FOR COMMERCIAL SAMPLES OF FROZEN PEAS

Commercial Samples	Enzyme Activity	Vitamin C Content	I_2-Reducing Value	A.A.C. / I.R.V.	Remarks
Plant MX	-	11.07	1.58	7.00	1948 Pack
Plant WP	-	8.10	1.40	5.78	1948 Pack
Plant SL	-	14.85	2.55	5.82	1948 Pack
Plant SC	-	6.75	1.20	5.63	1948 Pack
Plant BE	-	13.77	2.00	6.88	1949 Pack
Plant PS	-	8.90	1.55	5.74	1948 Pack
Plant PS	-	14.17	2.25	6.30	1949 Pack
Plant FRP	-	19.71	2.90	6.80	1949 Pack

V. SUMMARY AND CONCLUSIONS

Thomas Laxton peas and market peas were used for processing and freezing. The effect of blanching on the loss of total solids, ascorbic acid and iodine-reducing value of peas was studied. The loss of total solids by blanching ranged from 2.7 percent to 8 percent, ascorbic acid from 4.7 percent to 35.2 percent, and iodine-reducing value from 6.7 percent to 40.8 percent. Steam blanching caused smaller losses than did water blanching at the same temperature for the same time. Peas of tender texture lost higher amounts of water soluble constituents.

After five months of zero storage, the loss of ascorbic acid of blanched peas ranged from six to ten percent.

The ascorbic acid content and iodine-reducing value of commercial frozen peas have been investigated.

Enzyme tests are apparently unsuitable as a quality index for frozen peas. Neither ascorbic acid content nor iodine-reducing value alone was found to correlate with the organoleptic tests. The ascorbic acid content and iodine-reducing value ratio (A.A.C./I.R.V. ratio) was found to have a better relationship with the organoleptic tests for the frozen samples. The correlation coefficient between these two tests was found to be 0.706. It appears that the A.A.C./I.R.V. ratio could be used as a suitable objective method for determining the quality of frozen peas. This test might be given a trial by packers of frozen peas to measure the quality of their product. Frozen peas with a A.A.C./I.R.V. ratio below 6.5 can be rated only as fair or poor in quality.

Thomas Laxton peas have proved to be suitable for freezing. Among the frozen samples tested, Thomas Laxton peas had the highest A.A.C./I.R.V. ratio and the highest organoleptic score.

It should be emphasized that additional work is contemplated for newer varieties of peas processed in the laboratory as well as for commercial samples of frozen peas. Seasonal variations in any product of a biochemical nature must be taken into consideration. Plans are now being completed for the testing of newer varieties this year and subsequent years.

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