

1-1-1963

## Retention of vitamin C in turnip greens cooked by three different methods

Ann R. Stasch

Lois Kilgore

B. F. Barrentine

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### Recommended Citation

Stasch, Ann R.; Kilgore, Lois; and Barrentine, B. F., "Retention of vitamin C in turnip greens cooked by three different methods" (1963). *Bulletins*. 727.

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# **Retention Of Vitamin C**

## **In Turnip Greens**

### **Cooked by Three Different Methods**

**Mississippi State University**  
**AGRICULTURAL EXPERIMENT STATION**

**HENRY H. LEVECK, Director**

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# RETENTION OF VITAMIN C IN TURNIP GREENS COOKED BY THREE DIFFERENT METHODS

By ANN R. STASCH and LOIS KILGORE, Home Economics  
and B. F. BARRENTINE and J. D. CAIN, Chemistry

Turnip greens can provide a good dietary source of vitamin C for the people of Mississippi. Two or three generous servings of turnip greens per day can supply the entire recommended dietary allowance of vitamin C. The actual amount of vitamin C provided by one serving of turnip greens is, of course, variable. Part of this variation is due to difference in the amount of vitamin C contained in the turnip greens when they are harvested. The consumer has very little control over this, particularly if greens are purchased. Other variation results from the method used for cooking the greens. The person preparing the greens does have some control over this variable. The extent to which she exerts this control depends on her knowledge of its importance. This bulletin presents data on the vitamin C content of turnip greens before and after cooking by three methods in common household use. Recommendations are made as to the best method of preparation.

## Review of the Literature

An extensive literature exists concerning the change in vitamin C content of various vegetables after they are cooked. Although most of this literature deals with vegetables other than turnip greens, certain general principles are applicable to all green vegetables.

When green vegetables are boiled the actual destruction of vitamin C is quite small. However, some of the vitamin C originally present in the vegetables is

lost by extraction into the cooking water. When "pot liquor" is used for other purposes in food preparation, rather than thrown away, this loss becomes negligible. Variation in cooking method may also increase or decrease this loss. For example, slow simmering of vegetables, compared with cooking at the normal rate of boiling, increases the amount of vitamin C extracted into the cooking water (3). Long periods of time used for cooking turnip greens also result in a greater loss of vitamin C (6).

Although greater destruction of vitamin C by oxidation occurs during steaming of vegetables, less extraction into the cooking water takes place. Therefore, a greater retention of vitamin C occurs in steamed than in boiled vegetables. The greater destruction of vitamin C which occurs during steaming has been reported to be due to the fact that steam diffuses through the packed leaves more slowly than hot water penetrates. The air trapped between the leaves of turnips or other plants contains oxygen which reacts with vitamin C to oxidize and destroy it. If this air is removed rapidly, such as occurs when the leaves are plunged into hot water, very little time is available for oxidative destruction of vitamin C. This explanation forms the basis for the recommendation that green vegetables be placed in water which is already boiling, rather than in cold water (5).

Recommendations for cooking turnip greens usually include all of the above-mentioned points.

Acknowledgement is made to Mrs. Sue Woody, Technical Assistant in the Home Economics Department, and to Mrs. Gladys F. Boyette, Extension Specialist in foods and Nutrition, for their suggestions and criticism during the preparation of the manuscript.

### Objectives

The amount of vitamin C retained in cooked turnip greens, and therefore, the nutritive value of the greens, depends upon the method of cooking. Three methods in common household use are pressure cooking, short time boiling in minimum amounts of water and long time boiling in large amounts of water. Turnip greens, specially grown to contain variable amounts of vitamin C, were cooked by each of three methods and analyzed to determine the change in vitamin C content during cooking. From this data recommendations can be made as to preferred method of cooking for maximum vitamin C retention.

### Experimental Procedure

Shogoin and Purple Top White Glove turnips were grown on three experimental plots. Plot 1 received 2000 pounds per acre 8-8-8 fertilizer. Plots 2 and 3 received 3800 pounds per acre of 8-8-8 fertilizer and 900 pounds per acre of sodium nitrate. Excessive amounts of nitrate fertilizer have been shown to decrease the vitamin C content of turnip greens (7). Plots 1 and 2 were grown without artificial shading. Plot 3 was artificially shaded with plastic screening material, which decreased the light intensity 45 per cent. Turnip greens grown in shade are known to contain less ascorbic acid than those grown in direct sunlight. (1)

Turnip greens were harvested from each plot at weekly intervals. The same day each week was used for each plot and the turnip greens were harvested at the same time each day. The greens were washed thoroughly three times. Individual leaves were then cut in half down the mid-rib and blotted dry. Sufficient half leaves to make a weight of 300 grams were used for each cooking method. The other halves of the same leaves were analyzed as a raw sample in each case. This procedure helped to eliminate variability among the leaves.

The three cooking methods used were

as follows:

1. Seven minutes at 15 pounds pressure with  $\frac{2}{3}$  cup (159 ml.) water;
2. Twenty minutes in a covered pan with 2 cups (474 ml.) water; and
3. Two hours in a covered pan with 8 cups (1896 ml.) water

One-half teaspoonful of salt was added to the water for each cooking method. The turnip greens were added when the water was already boiling. After cooking, the greens were drained for two minutes to separate the liquid. Both raw and cooked samples were blended to make a homogeneous mixture. Aliquots of each mixture were analyzed for total vitamin C (8). All weights were reported and all calculations were made on the basis of wet weight of turnip greens.

### Results and Discussion

The average amounts of total vitamin C found, in milligrams per 100 grams of raw turnip greens, were as follows: Plot 1 - 1993.1; Plot 2 - 1748.8; and Plot 3 - 1518.2. The variable amounts of vitamin C initially present in the turnip greens enabled us to show whether loss of vitamin C was related to amount present.

#### Change in weight during cooking.

The weights of raw and cooked turnip greens were obtained for each method of cooking and compared to determine loss or gain in weight during cooking. The percent change in weight for the greens from each plot is given in Table 1.

The pressure cooked turnip greens lost an average of 8.0% of their original weight during cooking. The 20-minute boiled turnip greens gained an average of 5.0%, and the 2-hour boiled turnip greens an average of 1.8% of their original weights during cooking. Therefore, the yield of cooked turnip greens was highest for the pressure cooked greens, and intermediate for the 2-hour boiled greens. The lesser weight gain noted in turnip greens boiled in 8 cups of water than in 2 cups is presumed to be due to a

Table 1.—Change in weight<sup>1</sup> of turnip greens during cooking.

Cooking method	Plot 1		Plot 2		Plot 3	
	Cooked wt.	Change	Cooked wt.	Change	Cooked wt.	Change
	gm	%	gm	%	gm	%
Pressure cooked	278.0	-7.3 <sup>2</sup>	271.4	-9.5	270.8	-9.7
Boiled 20 minutes	319.5	+6.5 <sup>3</sup>	323.0	+7.7	302.6	+0.9
Boiled 2 hours	322.4	+7.5	302.6	+0.8	291.2	-2.9

<sup>1</sup>Raw weight was 300 gm in each case.

<sup>2</sup>Minus sign indicates loss in weight.

<sup>3</sup>Plus sign indicates gain in weight.

greater extraction of water soluble material from the turnip greens into the cooking water in the former case.

#### Retention of vitamin C in cooked turnip greens.

The amount of total vitamin C actually destroyed during cooking averaged 51.2% during pressure cooking, 25.3% during 20 minute boiling and 21.4% during 2 hour boiling. Even though less vitamin C is destroyed in the boiled greens, it must be remembered that some of that remaining is dissolved in the cooking liquor. If this liquor is used in other food preparations, the vitamin C in it is utilized by the consumer. More often, however, the cooking liquor, or a large part of it, is discarded, thereby causing the vitamin C dissolved in it to be lost to the consumer.

Since further use of the liquor remain-

ing from the cooking of turnip greens is optional with the individual user, the amount of total vitamin C actually retained in the turnip greens is considered to be of greater nutritional significance. The amounts of vitamin C retained by the turnip greens after cooking are given in Table 2.

From the data in Table 2 it can be seen that maximum retention of total vitamin C occurs in the pressure cooked turnip greens. Minimum retention of vitamin C is found in the 2-hour boiled greens. The initial amount of vitamin C present does not have any effect on the amount retained by the cooked greens. However, since the percentage of the original amount retained is approximately the same in each case, more vitamin C is found in the cooked greens which had the largest amount to begin with.

Table 2.—Retention of Vitamin C in turnip greens cooked by three methods.

Cooking method	Total vitamin C		
	Raw	Cooked	Retention
	mg/100 gm	mg/100 gm	%
	Plot 1		
Pressure cooked	133.7	59.6	44.6
Boiled 20 minutes	128.9	55.2	42.8
Boiled 2 hours	142.7	47.1	33.0
	Plot 2		
Pressure cooked	107.8	48.0	44.5
Boiled 20 minutes	115.9	48.2	41.6
Boiled 2 hours	113.1	34.9	30.9
	Plot 3		
Pressure cooked	83.9	41.8	49.8
Boiled 20 minutes	79.8	42.6	53.4
Boiled 2 hours	86.2	20.4	23.7



In order to compare the actual nutritive values of the drained turnip greens cooked by each of the three methods, the data is reported in Table 3 in the form of percentage of the recommended daily dietary allowance supplied by one average serving (2).

The data in Table 3 show that pressure

cooked turnip greens provide a larger proportion of the daily requirement of vitamin C in one serving than do the greens cooked by either of the boiling methods. This difference is especially notable in the case of the turnip greens from Plot 3, which contained the lowest amount of vitamin C at harvest.

Table 3.—Percentage of recommended daily dietary allowance (RDA) of vitamin C found in one serving (72.5 grams, wet weight) of turnip greens cooked by three methods.

Method of cooking	Plot 1	Plot 2	Plot 3
	% RDA	% RDA	% RDA
Pressure cooked	58.2	44.0	41.5
Boiled 20 minutes	52.7	45.5	38.8
Boiled 2 hours	43.9	43.7	18.1

### Summary and Conclusions

The amount of vitamin C initially present in turnip greens has very little effect on the amount of vitamin C retained in cooked greens. Three methods of cooking were used: pressure cooking, short time boiling in a small amount of water and long time boiling in a large amount of water. The greatest yield of cooked greens is obtained with the short time boiling method. However, from the standpoint of nutritive value, the pressure cooked greens retain the largest quantity of vitamin C and, therefore, provide the greatest percentage of the daily allowance of vitamin C per serving.

Recommendation as to the preferred method of preparation must take into consideration whether some, none, or all

of the cooking liquor is used in other food preparations. If all of the cooking water is consumed, there is little preference in preparation method. However, when large amounts of water are used for cooking the greens, there is a greater likelihood that at least a portion of the cooking liquor will be discarded. Since the use of long time cooking methods results in the largest quantity of vitamin C being extracted into the liquor, this method is considered to be the poorest method of preparation.

If none of the cooking liquor is used in other food preparations, pressure cooking is the recommended method of preparation of turnip greens.

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