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# Peroxidase Inactivation And Ascorbic Acid Degradation Of Selected Vegetables During Microwave Blanching

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**ABSTRACT**

Effect of microwave blanching on residual peroxidase activity and ascorbic acid degradation in carrot, zucchini, cabbage, green beans and green peas was studied. First order kinetic expression simulated peroxidase inctivation and ascorbic acid degradatin. The time required to reduce the enzyme activity by a factor 10 was found to be shorter in green beans and peas. Ascorbic acid retention was found to be higher in microwave blanched green beans. For equivalent preoxidase inactivation, more losses of ascorbic acid were determined in blanched zucchini, cabbage and carrot.

**MİKRODALGA İLE HAŞLAMA SIRASINDA ÇEŞİTLİ SEBZELERDEKİ PEROKSİDAZ ENZİMİNİN VE ASKORBİK ASİTİN BOZUNMASI**

**ÖZET**

Mikrodalga ile haşlamanın askorbik asitin bozunması ve peroksidazın etkinliğinin yok edilmesi üzerindeki etkisi havuç, kabak, lahana, taze fasülye ve bezelye de incelenmiştir. Askorbik asitin bozunması ve enzimin etkinliğinin yok edilmesi birinci derece bir reaksiyon olarak ifade edilmiştir. Enzim etkinliğini 10 kat azaltabilmek için gerekli olan süre taze fasulye ve bezelyede daha kısadır. Askorbik asitin tutunması haşlanmış taze fasulyede en fazladır. Haşlanmış havuçta, lahanada ve kabakta ise askorbik asitin kaybı çok fazladır.

## INTRODUCTION

Enzyme activity can affect the quality of vegetables especially in frozen and dried vegetables. Upon prolonged storage. The enzymes presented in vegetable tissues may cause the formation of colored products and off-flavor development. One way to prevent the changes in quality due to enzyme activity is blanching of vegetables prior to processing.

Blanching may be done by several ways such as steam blanching and hot water blanching. Microwaves can also be used for blanching of vegetables. It is possible, depending on the food composition and mass and type of conventional heating being compared, to achieve as much as 75 % energy saving by microwave heating (Baldwin, 1983). The Institude of Food Technologists Expert Panel on Food Safety and Nutrition (IFT, 1989) reported that vitamin retention in microwawe foods in improved because heating time is shortened, but that retention varies with time, internal temperature, product type, and oven size, type and power. Quenzer and Burns (1981) reported that microwave blanched freeze dried spinach contained more ascorbic acid than freeze dried spinach blanched by conventional methods. Retention of ascorbic acid and chlorophyll was higher in microwave blanched green beans and minimum adequate blanching time for peroxidase enzyme inactivation was shorter in microwave oven (Muftugil, 1986). There are however, other studies suggesting that nutrient retention in microwave processing is not much greater than in conventional processes. Drake et al. (1981) reported that ascorbic acid values were lower in microwave blanched asparagus, green beans, and sweet corn. Lane et al. (1984) reported that ascorbic acid retention was approximately same for microwave, steam and hot water blanched beans, purple hull peas and yellow squash. The purpose of the present study was to determine the degradation rate of ascorbic acid and inactivation rate of peroxidase in selected vegetables during microwave blanching.

## MATERIALS AND METHODS

Raw Materials : Fresh vegetables available in the local market were used. All were rinsed in tap water and prepared for blanching in the following manner: green beans were cut into 4 cm pieces, green peas were shelled, carrots and zucchini were sliced into uniform 1 cm sections and cabbage was cut into pieces.

Methods : vegetables were spread in a single layer on glass plates and placed in a microwave oven (Vestel, model no 5053 T, 2450 MHz.). Samples were blanched for 0,5, 1, 1.5, 2, 2.5, 3 and 4 min. The trays were rotated automatically to distrubute the microwaves for uniform blanching treatment, samples were subjected to peroxidase test to determine adequacy of the blanching with respect to enzyme destruction. Also ascorbic acid determinations were performed.

The Indophenol - Titration method (AOAC 1980) was used to determine ascorbic acid in fresh and blanched samples. Peroxidase activity was measured by using quaiacol and $H_2O_2$ as substrates. One unit of peroxidase activity was defined as a change in absorbance of 0,001 per min. (Hemeda and Klein, 1990; Lee et al., 1984).

## RESULTS AND DISCUSSION

The primary effect of exposing a biological material to microwave is a volumetric heat generation that induces a temperature rise in the material. Microwave blanching may possess certain advantages. A conventional blanching operation regquires large quantities of water, causing substantial waste water disposal cost. In principle, microwave heating could reduce this indirect heating requirement and water use.

Blanching involves measuring the rate of enzyme destruction, such that the blanching time is just long enough to destroy th eindicator enzyme. Since peroxidase is very resistant to heat inactivation and is widely distributed in plant tissues, and also very sensitive and simple colorimetric tests are available to measure its activity, it has been used as an indicator for the effectiveness of heat treatments. There is considerable evidence that the quality of the blanched and frozen product is better if there is some peroxidase activity left at the end of the blanching. One of the problems in completely inactivating peroxidase is the presence of 1 - 10 % of more heat stable isozymes of peroxidase in most vegetables. For best quality products, it was recommended to carry on blanching until the following percent peroxidase activity is left: peas 6 - 6.3 %, grean beans 0.7 - 3.2 %, cauliflower 2.9 - 8.2 % and Brussels sprouts 7.5 - 11 %. (Williams et al., 1986). Generally a residual peroxidase activity of about 8 - 9 % after blanching is recommended for preservation by freezing. Blanching of vegetables in a microwave oven provided sufficient enzyme inactivation. By assuming a first order kinetic model for enzyme inactivation, it is possible to analyze data. The modelseemed to fit the experimental data well as shown in Fig 1 - 5. The rate constants for the peroxidase inactivation are shown in Table 1 along with D values for different ve-

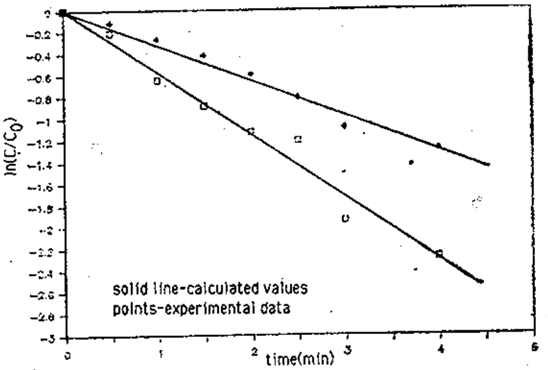


Fig. 1 - Variation of peroxidase activity (□) and ascorbic acid concentration (+) in carrot with time.

**Tablo 1. Reaction rate constants, correlation coefficients and D values of perixidase inactivatian and ascorbic acid degradation.**

| Vegetable | Peroxidase | | | Ascorbic acid | | |
|---|---|---|---|---|---|---|
| | k (1/min) | r | D (min) | k (1/min) | r | D (min) |
| Carrot | 0.573 | 0.98 | 4.02 | 0.323 | 0.99 | 7.13 |
| Zucchini | 0.485 | 0.94 | 4.75 | 0.314 | 0.99 | 7.33 |
| Green Beans | 0.881 | 0.97 | 2.61 | 0.167 | 0.98 | 13.79 |
| Green Peas | 1.070 | 0.95 | 2.15 | 0.327 | 0.98 | 7.04 |
| Cabbage | 0.336 | 0.98 | 6.85 | 0.181 | 0.99 | 12.72 |

getables. D values were obtained by calculating the time required to reduce the activity to 10 % of the initial value. The time required to reduce the enzyme activity by a factor 10 was shorter for green beans and peas.

A second phase of the experiment was to evaluate the effect of blanching time on ascorbic acid content of vegetables. Ascorbic acid was chosen for testing, both for its importance as a nutrient and as an indicative component of the process material, demonstrating a high degree of water solubility and heat lability. Blanching time also showed a significant effect on ascorbic acid content. As might be expected, increased time reculted in reduced ascorbic acid levels. The rate of loss followed first order kinetics. The degradation of ascorbic acid in carrot, zucchini and green peas was faster than its degradation in green beans and cabbage. The corresponding average losses of ascorbic acid after blanching were 72 % for carrot, % 77 for zucchini, 35 % for

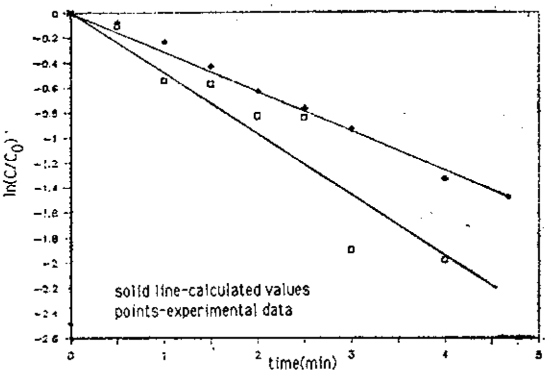


Fig. 2 - Variation of peroxidase activity (□) and ascorbic acid concentıation (+) in zucchini with time.

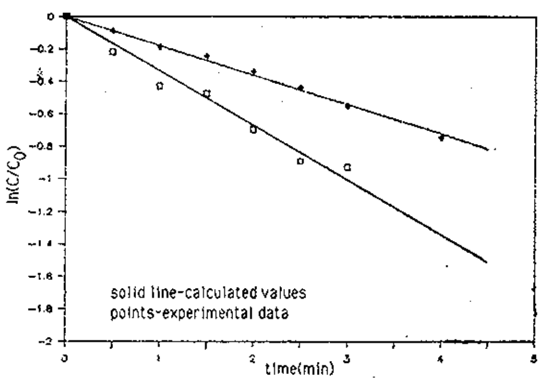


Fig. 3 - Variation of peroxidase activity (□) and ascorbic acid concentration (+) in cabbage with time.

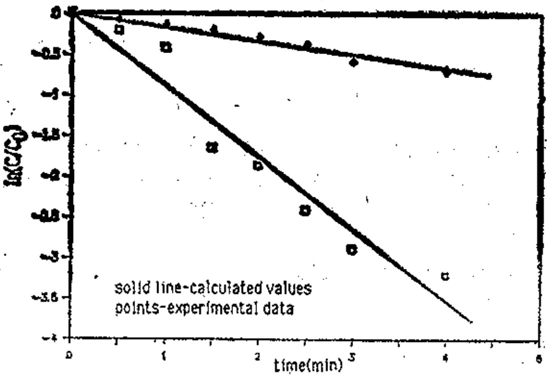


Fig. 4 - Variation of peroxidase activity (□) and ascorbic acid concentration (+) in green beans with time.

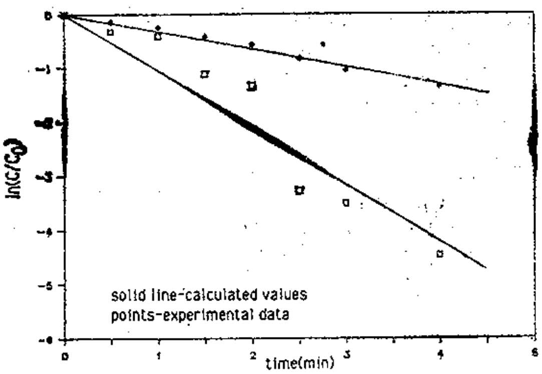


Fig. 5 - Variation of peroxidase activity (□) and ascorbic acid concentration (+) in peas with time.

green beans, 50 % for peas and 71 % for cabbage in order to obtain 10 % retention of enzyme activity. Ascorbic acid retention was found to be higher in microwave blanched green beans. The ascorbic acid content of blanched cabbage, zucchini and carrot was very much affected by blanching.

In conclusion, microwave heating colud be considerably effective for inactivating enzymes in vegetables. The ascorbic acid content of certain vegetables can be very much affected by microwave blanching. More research is needed in this area. There is a need for additional research on modes of heat and mass transfer within the product during processing. Further studies must be performed on the nutritional quality of the vegetable heated with microwaves by considering different parameters such as internal temperature, time, oven size, type and power and also product type and size.

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