STUDIES ON THE PRESERVATION BY LOW TEMPERATURE FOR SOME FRUITS AND VEGETABLES

BY

SOHAIR HAMED HAMDI

B.Sc. Agric. (Food Science)
Ain Shams University (1971)

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Name : Schair Hamed Kandil.

Title : Studies on the Preservation by low Temperature for some Fruits and vegetables.

This thesis for the M.Sc. degree has been approved by :

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Committee in charge.

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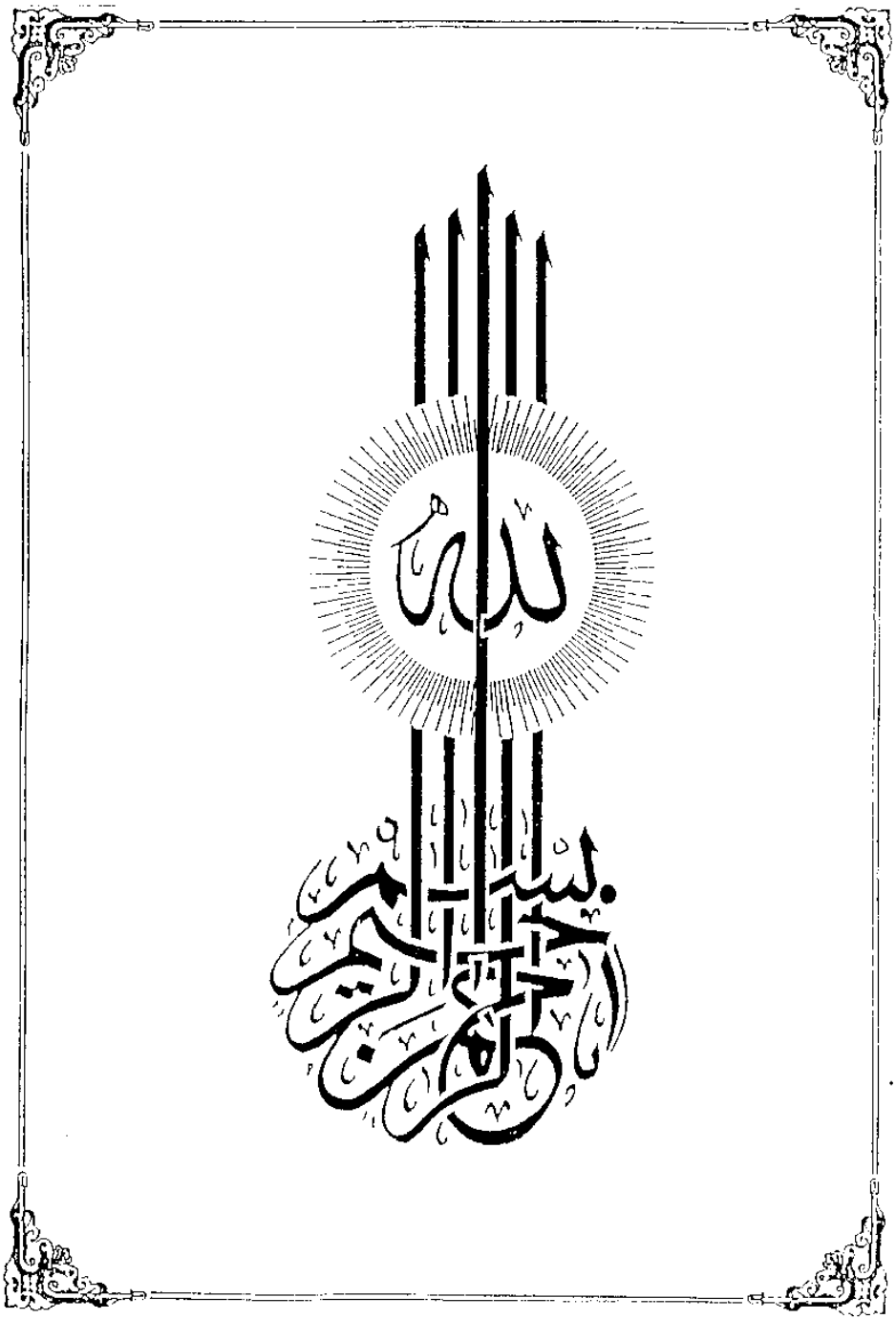

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C O N T E N T S

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I- INTRODUCTION

Quality changes in vegetables and fruits may result from three main types oi reaction which are namely microbiogical, or enzymatic and or chemical activities. These are chemical activities within the product. It is well known that active enzyme systems can spoi vegetables and fruits even at subzero temperatures and low moisture levels.

Enzymes in frozen foods continue to function, very slowly to be sure, in food held at low temperature. If the quality of the frozen food is to be maintained, the enzymes be inactivated. Otherwise, they will cause off-flavors and discolor the food. Even at 0°F (-17.78°C) the enzymes are not inactivated, but only slowed down and within a week or month, the frozen food may show evidence of abnormal odors and tastes.

Frozen industry has been started in Egypt recently. One of the important point about this industry is the control in the changes of the quality of the products during processing and storage. Enzymatic changes has to be carefully studied in each product to establish specific measures to prevent it. Since early stages, peroxidase enzyme

was taken as an indication for any possible activities of deteriorating enzymes either during processing or subsequent storage. It is well known that the complete destruction of peroxidase enzymes from vegetables and fruits before freezing process would certainly lead to a better quality product. This is why proper blanching of vegetables and fruits should be used with raw material before freezing. The difficulty in proper control of blanching process is usually resulting from the fact that peroxidase enzyme may be reactivated during storage of frozen vegetables and fruits and would definitly reduce the quality of the product before consumption. Hence carefull attention should be given to this point to make sure that peroxidase enzyme in fruits and vegetables is not only immediately inhibited after blanching but also during storage of frozen products. To insure that this would happen, information about the kinetics of inactivation by heat and reactivation (during storage) of peroxidase for each fruit and vegetable should be determined.

Accordingly the aim of this thesis is to study the following:

1. Inactivation kinetics of peroxidase from some vegetables and fruits.

2. Heat resistance parameters of peroxidase from some vegetables and fruits.

3. Effect of pH, sodium chloride, and sucrose on inactivation and reactivation of peroxidase activity from vegetables and fruits.

4. Effect of storage periods on peroxidase activity from frozen vegetables and fruits.

II- REVIEW OF LITERATURE

(A) Factors Affecting Peroxidase Activity in Vegetables and Fruits:

1- Thermal destruction and stability of peroxidase:

Campbell (1940) pointed out that blanched vegetables, that had negative catalase and peroxidase reaction soon after blanching, may have a positive and negative catalase reaction after freezing and storage.

Balls (1942) summarized the problems involved in destruction of enzymatic activity by heat and stressed the difficulty of complete destruction. He added that the product of decomposition by heat might exert a slight catalytic action with regeneration in activity. He also mentioned that the catalase and peroxidase could be regenerated during freezing storage.

Nebesky et al.(1950) studied the effect of time and temperature relationships, during processing, on the peroxidase of canned acid foods. He mentioned that not only the destruction of microorganism in processed foods must be emphasized, but also attention should be given to the destruction of peroxidase enzyme. Peroxidase heat - resistance measured by guiacol substrate was greater than,

when measured using O-phenylendiamine, catechol, benzidine, hydroquinone, and pyrogallol. hence, guiacol was selected as the preferable substrate in measuring peroxidase activity and destruction under particular conditions.

Esselen and Anderson (1956) found that, during a temperature ranging between 215° to 290°F. (101.6 to 132.2°C), the degree of heat to prevent regeneration of peroxidase activity in vegetable tissues was 2 to 4 time greater than that required to destroy the enzyme on the basis of tests made immediately after heating. They added that the thermal resistance of peroxidase was characterized by much higher Z values than with bacterial spores.

Farkas et al.(1956) studied the regeneration of peroxidase in peas at temperatures used in normal and high temperature short time (HTST) procedures. They reported that the heat-inactivation curve for peroxidase showed Fo of 6 minutes and a "Z" value of 48°F between 100 and 150°C (212 and 312°F). Their data indicated that an Fo of 100 at 140°C was necessary for complete peroxidase destruction.

Vetter et al. (1958) determined enzyme activity in corn which had been steam blanched for various periods

from 0 to 8 minutes and found that enzyme activity was reduced by increasing the blanching time.

Lopez et al.(1959) investigated the effect of blanching time on peroxidase and catalase activity in peas, and found that blanching for one minute in boiling water (212°F., 100°C.) inhibited approximately 70 to 90 percent of the peroxidase and 80 to 100 percent of the catalase activity. After a two-minutes blanching, approximately 90 to 100 percent of the peroxidase and 98 to 100 percent of the catalase had been inhibited. A three-minutes blanching resulted in 98 to 100 percent inactivation of activity. No significant catalase or peroxidase regeneration was observed after 0°F. at a storage period of 29 months.

Doueil and Esselen (1959) described a quantitative method for determining the peroxidase activity after heating using 0.04 ml samples, in the cup of thermoresistometer. Thermal inactivation curves for peroxidase of green beans and turnips possessed Z values of 41 and 43°F. where as their F_{250} values were 0.06 and 1.8 minutes respectively. The thermal destruction curves required to prevent regeneration of peroxidase for green beans and

turnips showed Z values of 47 and 46°F whereas the F_{250} values were 3.0 and 11.3 minutes respectively. These values (Z and F_{250}) were 5 to 6 times higher than that required to inactivate the enzyme when measured immediately after heating.

Zoueil and Esselen (1959) also reported the activation energy for green beans peroxidase as 34.4 and 19.6 K calorie with a critical temperature at 220°F. The activation energy for turnip peroxidase was found to be 49 K calorie at the same temperature.

Baker and Goldblith (1961) investigated the effect of both heat and ionizing radiations on peroxidase activity in green beans. Ionizing radiation in large doses decreases peroxidase activity in green beans. It is equivalent to mild short-term heat treatment. When a heat blanch is used, ionizing radiation has no practical advantage or disadvantage.

Sastry et al.(1961) purified peroxidase from Annana squamosa pulp and measured its catalytic oxidative effect by the brown color with guaiacol as substrate. The purified enzyme was free from ascorbic dehydrogenase and tyrosinase. The influence of temperature, ph, SO_2, H_2O_2 ,

ascorbic acid, sucrose, and KCN on the enzyme activity were studied.

Bottcher (1961) determined the activity of peroxidase from cauliflower, brussels sprouts, spinach, carrots, and asparagus of various varieties. He found that the enzyme activity of these vegetables were in the range of 5-110 mg. purpurogallin/g. fresh substance. Young tissue of cabbage, outer layers of peas, and asparagus had the highest activity, while carrot's showed the lowest peroxidase activity.

Woerner (1961) studied physico-chemical considerations on the heat injury and regeneration of lactoperoxidase. He found that, the horseradish peroxidase loses its original state faster than lactoperoxidase but the former is much less sensitive to high temperatures.

Bottcher (1962 b) studied the inactivation of plant tissues enzymes by hot water blanching. He found that, the enzyme inactivation increased with rising temperature and prolonged effect of hot-water blanching depended on the heat-penetration which, in turn, depended on the sizes of the vegetable pieces.