TECHNOLOGICAL STUDIES ON THE ACCEPTABILITY OF THE KINDS OF SHRIMPS IN U.A.R. FOR PRESERVATION BY FREEZE-DRYING

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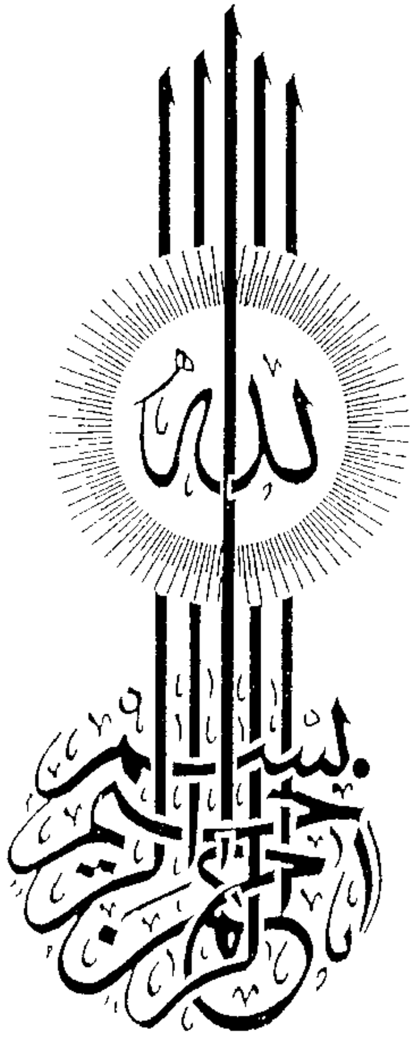
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INTRODUCTION

The dehydration of products while in the frozen state has been termed "freeze-drying", "drying by sublimation" or "lyophilization". This means that ice in the frozen product goes directly from solid to vapor, by passing over the liquid phase. The temperature must, of course, be kept low enough to avoid melting of any ice crystals present. Beside the process must take place in a vacuum chamber at a very low pressure. Moisture removal from foods facilitates storage for long periods of time without refrigeration. Freeze-drying from the standpoint of industry is defined as a unique food preservation process that removes moisture from foods without appreciably changing the shape, color or taste of the products. Rehydration is accomplished rapidly by simply adding water(Bird, 1964 A).

Freeze-drying overcomes in whole or in part, the major undesirable changes usually noted in ordinary high temperature or vacuum drying of biological materials. Keeping the material frozen until it is dry eliminates shrinkage and migration of dissolved materials, inhibits chemical reactions and minimizes loss of volatile constituents. The dry product is porous and will reconstitute almost instantly. Freeze-dried food products, when reconstituted, are frequently difficult to distinguish from the fresh products. Furthermore, such freeze-dried products can be kept for extended periods of time under nonrefrigerated storage without serious impairments of their properties.

Dried foods have the advantages over canned and frozen foods of less weight and greater storage stability at room temperature. Among the dehydration methods applicable to foods, freeze-drying is the ideal method for the maintenance of the desirable characteristics.

Although freeze-drying had been known since the beginning of this century, its virtues were not fully appreciated until just before the beginning of the second World War, when apparatus for laboratory and small-scale commercial use was first becoming available (Greaves, 1954). The freeze-drying industry is now growing up rapidly. Commercial freeze-dried food items were introduced on the U.S. market about 1959. New items have been forthcoming each year till they reached 50 to 60 different freeze-dried foods for sale about 1964. At

1962, there were about 6.5 million pounds of freeze-dried foods. In 1963, the volume of freeze-dried foods increased almost about 80%. This year, i.e., 1970 a volume of 250 million pounds of input freeze-dried foods (per year), is expected, and this results in 75 million pounds of freeze-dried products (Bird, 1963). In 1964, the number of freeze-dried food processors reached 56 (of which 21 are in North America and 27 in Europe); and food freeze-drying equipment manufacturers reached 23 companies, other, than 53 companies working in the field of freeze-dried foods (Bird, 1964 B).

Freeze-dried foods may be used in schools, hospitals and restaurants, and other away-from-home eating places. The largest buyer of freeze-dried products in the U.S. is the Armed Forces. Recently they have begun to use freeze-dried food items in their regular menus. Freeze-dried foods are also used for special purposes such as in the space program. They are also added to soups, puddings, preserves, ice cream and bakery products. Such items can improve food quality and the material characteristics of processed foods (Bird, 1964 C).

In U.A.R. freeze-drying began very recently and had not yet exceeded the experimental stage. However, it is expected in the near future that, freeze-dried foodstuffs will be produced on commercial scale in this country. The priority would be for food products of biological and economical values which will find a good market in Europe and other similar countries.

Shrimp was one of the first foods to be freeze-dried (Kermit, 1954). Several Kinds of freeze-dried shellfish, such as shrimp and crab have been market-tested and pronounced assured success (F.D. Report 1964). At present, freeze-dried shrimp is commercially produced both in U.S. and Europe (Miner, 1965). Recently, a preliminary report on cost of freeze-dried shrimp has been published (Nixon, 1966). However, there have been many successful attempts to freeze-dry raw shrimp. The quality was much superior to that of shrimp prepared by the vacuum - contact - plate dehydration which is the most competitive method to freeze-drying. Shrimp dried by sun drying is very inferior in quality compared to that produced by freeze-drying or by the vacuum contact - plate dehydration method (Harper and Tappel, 1957).

Two considerable advantages are claimed for shrimp processed by freeze-drying, these bing much reduced weight and good quality. Packed and sealed cans of freeze-dried shrimp require no refrigeration and are said to last indefinitely (Idyll, 1963).

The most important varieties of Egyptian shrimp are: Red, Tiger, and White shrimp. The white variety is known to be the biggest in size. The annual catch of shrimp in U.A.R. amounts to about 5000 tons in 1963 (Table 1) and that occupies the second place after sardine. The major part of this amount is marketed as fresh shrimp. Dried, dehydrated and freeze-dried shrimp are not produced in U.A.R. on a commercial scale, while the production of frozen shrimp represents 20% of the total catch (Awad, 1962).

Table 1 : Annual catch of shrimp in U.A.R.*

Year	Amounts in tons
1959	7788
1960	9897
1961	1367
1962	7955
1963	5009

* Egyptian general organization for aquatic resources.

AIM OF THE INVESTIGATION

The present investigation involves the following studies :

1) The rate of freeze-drying of shrimp caught from Egyptian water.

2) The effect of the freeze-drying process on some chemical and bacteriological properties of shrimp.

3) Effect of packaging and storage under different conditions on certain chemical and bacteriological freshness indices of shrimp.

REVIEW OF LITERATURE

Freshness indices and treatments

Various investigators studied the treatments and keeping quality of shrimp. Henning (1942) stated that the causes of its rapid decomposition and poor quality of shrimp were due to: poor care preparation of the shrimp on the boats, holding the raw shrimp too long, shelling by hand, insufficient and irregular sterilization, and storage under adverse conditions. Shimizu and Hujita (1954) mentioned that the taste of shrimp was closely related to the amino nitrogen, particularly the monoamino nitrogen contents. they also stated that the total nitrogen and amino nitrogen concentration in shrimp were found in large amounts in shrimp which showed more intense taste and in small amounts in shrimp of less intense taste. Bailey et al. (1956) gave a general review of chemical, physical and microbiological tests useful for determining the relative quality of ice stored shrimp. These tests were taken as indices of quality in relation to organoleptic changes in such a product. Glycogen sugar, lactic acid and acid soluble orthophosphate contents can be used for relative comparison of shrimp during their prime quality phase. Other useful tests are pH, amino nitrogen, degree of dehydration of water-insoluble protein, and B-vitamins content. Tests useful for determining onset of spoilage of ice stored shrimp were, trimethylamine nitrogen, volatile acids, bacterial population, sulphydryl groups determined by iodine titration, and Nessler ammonia. In most instances, individual tests are not conclusive for objective quality evaluation of shrimp, but rather are useful as relative quality indices when used in various combinations. However, a trimethylamine nitrogen value of 1.5 mg/.100gms. of shrimp tissue and a bacterial count of 10×10^6 per gram of headless shell on shrimp or higher are indicative of unacceptable quality. Collins et al. (1960) reported that the objective tests suitable for quality evaluation of raw shrimp that had been held in ice or refrigerated seawater were (I) trimethylamine and volatile acids as index of bacterial spoilage, (2) amino nitrogen, non-protein nitrogen, and total nitrogen as index of enzymic action, and (3) total solids and total chloride for general characterization. Hussien (1969) found the following values: 19.08 mg./100gms. for total volatile nitrogen, 7.07 mg./100gms. for trimethylamine nitrogen and 250 mg./100gms. for amino nitrogen calculated on fresh weight basis during his studies on Egyptian market shrimp (Tiger variety).

Fieger and Du Bois (1946) and Fieger et al. (1950) stated that chemical changes occuring in fresh whole shrimp during handling, processing, and storage were of two types; bacterial which was caused by bacteria present in the shrimp and the containers in which the shrimp was handled, and enzymic which was caused by the enzymes present in the digestive tract of the shrimp. The number of bacteria present alone often was not enough to cause rapid deterioration. Velanker and Gavidan (1958) reported that the objective tests are useful for assessing the number of days elapsed in ice storage which reflect the early changes occurring in prawns before the onset of spoilage are essential for quality control in the prawn processing industry. Decrease in amino nitrogen was more regular than the decrease in the orthophosphate. Also there was close agreement in the amino nitrogen values of the Mandapam prawns and Cochin prawns taken from different species and different environments indicate that definite ranges of amino-N. values are associated with the number of days in ice storage. The rapid decrease in amino-N. was arrested about the 6 or 7 day. The mechanism of the decrease in the amino-N. during ice storage is not clearly elucidated yet; but experiments have shown that leaching by contact with melting ice is the most significant factor. The loss of free amino acids by leaching may itself contribute to a lessening in the flavor of the prawn meat. According to Kurtzman <u>et al</u>. (1959) measurments of free ammonia nitrogen content indicated that some degree of decomposition of protein or of other nitrogen containing compounds has occurred during spoilage, Determinations of total plate counts indicated that the bacterial population was nearly 500 fold greater in the spoiled than in the unspoiled shrimp. These results suggest the possibility that the increased bacterial population may be responsible for the increase in cystine and ammonia nitrogen of the spoiled shrimp. Bethea and Ambrose (1961) studied the drip obtained by thawing frozen shrimp held under varying conditions of storage. Trimethylamine nitrogen was of no value as an indicator