SOME STUDIES ON DEHYDRATION OF EGG WHITE

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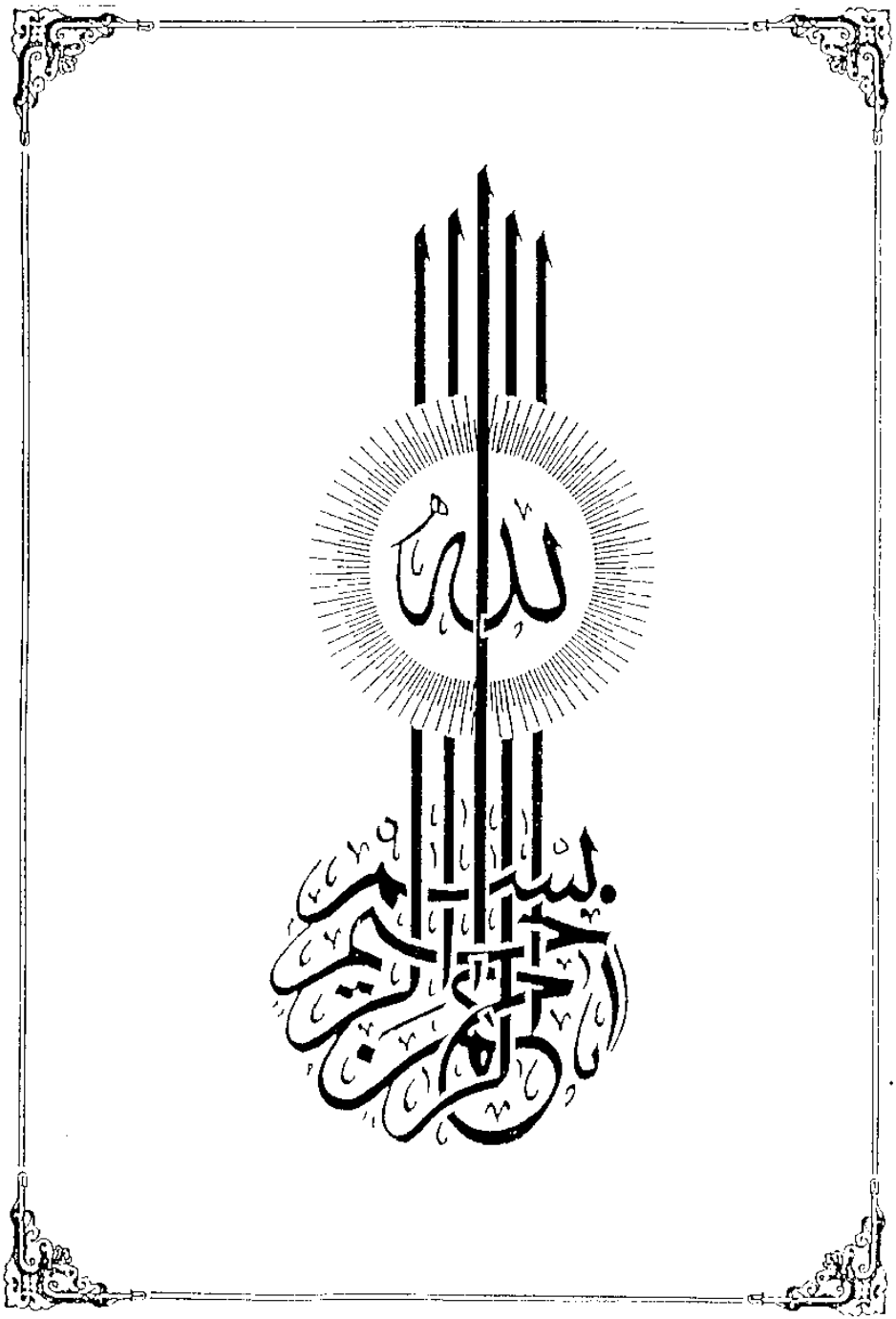

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INTRODUCTION

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Dried eggs have been in use in the early times, especially in the U.S.A. since about hundred years ago. The pan-drying of the egg white industry together with the spray-drying of egg white was developed in the States and the scale production started nearly in the year 1940.

Generally speaking the demand on the use of the dehydrated egg white began to increase for many food industries such as an adhesives for cork in bottles, capsules in carbonated beverage plants, coating of roasted coffee, in ready make cakes, in purification of medical syrups, and in School lunch programs.

Many advantages for the use of the dehydrated egg white, should be mentioned such as storing at low cost under dry storage or refrigeration in small room, low transportation, and the shelf life of egg increase by the dehydration.

In Egypt the demand on the dried egg albumen is increasing for many food industries. For this reason the dried egg albumin is imported from foreign countries such as Great Britain and the United States of America.

Thus it was thought advisable to make an attempt for the preparation of the dried egg white in Egypt for the safe of our economy. This necessitates to study as possible in this work the following points:

1- Methods that can be used for the removal of glucose from liquid egg albumen before dehydration. These include enzymatic treatment, yeast fermentation and bacterial utilization.

2- The possibility of producing dried egg albumen by spray-drying and pan-drying processes.

3- Quality measurements of the produced dried albumen in comparison with imported samples of spray dried albumen.

REVIEW OF LITERATURE

The literature concerning the studies of egg white, yolk and whole egg are so enormous that it can hardly be covered in this thesis. However, the literature deals with the biochemical view of egg albumen, the removal of sugar from the liquid egg albumen before dehydration, and the dehydration of liquid egg albumen are cited here.

I- Biochemical View of Egg Albumen

Albumen is the clear jelly-like material surrounding the yolk of the fresh egg. It is mainly water in which a complex mixture of proteins and a small proportion of the salts are dissolved. The gross chemical composition of liquid egg white, is 87.0 % moisture, glucose 0.3 %, 12.5 % protein, 0.3 % fat and 0.3 % mineral salts (Margaret 1966). Matz (1960) reviewed it as 87.7 % water, 12.3 % solids, 0.3 % sodium chloride, 10.7 % protein, 0.38 % glucose and 0.0029% cholesterol. Berglquist (1960) cited that egg white consists of thick and thin portions that are very

total solids) than any of the other proteins, and ovomucin is the protein credited for providing the structure of the thick white.

By using different techniques including the classical immunological procedures (Kaminski 1942), ion exchange chromatography (Rhodes et al. 1958) Starch gel electrophoresis (Feeney et al. 1963) and more, with conventional fractionation procedures (Lush 1961, and Feeney et al. 1963) egg white proteins have been examined.

The following table indicates the biochemical functional properties of egg white proteins.

Table (1): The biochemical composition of egg white*

Constituent	Approx. amount percent	Approx. I.P.**	Approx. M.W.	Unique properties
Ovalbumen	54	4.6	45,000	Denatures easily, has sulfhydryls.
Conalbumen	13	6.6	77,000	Complexes of iron, antimicrobial
Ovomucoid	11	4.3	28,000	Inhibits trypsin
Lysozyme	3.5	10.7	15,000	Enzyme for polysaccharides, antimicrobial.
Ovomucin	1.5	?	?	Viscous, high sialic acid.
Flavo protein-apoprotein	0.8	4.1	35,000	Binds ribflavin.
Proteinase-inhibitor	0.1	5.2	?	Inhibit the enzyme bacterial proteinase.
Avidin	0.05	9.5	?	Binds biotin, antimicrobial.
Unidentified-protein.	8.0	5.5,7.5	?	Mainly globulin.
Non-protein	8.0	-	-	Primarily half glucose and half salts.

* On a dry basis, egg white usually contains 10-12 percent solids.

** Approximate iso electric point.

II- Removal of Glucose from Liquid Egg White

Dehydration of liquid egg white without removal of glucose causing poor storage stability of dried product. Stewart and Kline (1941),and Bate- Smith and Hawthorne (1945) found that egg product dried from albumen without depleting the natural glucose deteriorated much more rapidly than the processed one. Stewart and Kline (1948), Kline and Stewart (1948), and Forsythe (1963) reported that, the aldhydic group of the glucose reacts with the amino group of the protein resulting in browning and insolubility of the dried product. They added that the reaction proceeds much more rapidly in presence of high moisture than at low, thus glucose in egg white must be removed prior to drying to retard this Miallard reaction. The removal of glucose is accomplished by using one of the next three processes:-

1- Bacterial fermentation:- A controlled bacterial culture of a glucose utilizing organism of a type that does not constitute a health hazard is commonly used. Here, the acidity of the egg liquid is adjusted by appropriate food acid to create an

environment that favors the optimum glucose utilization by the organisms.

2- Yeast fermentation:- In this method the "resting cell" technique was used. The pH must be adjusted to obtain optimum growth.

3- Enzymatic treatment:- The enzyme glucose oxidase was used by which the glucose of the egg white is oxidized to gluconic acid. In this case, it is necessary to supply a source of oxygen which is usually, hydrogen peroxide.

1- Bacterial Utilization :

The fermentation of egg white has been carried out for years, but it has not until 1941, that the benefits achieved from fermentation were fully realized (Stewart and Kline 1941). The litrature dealing with this subject revi-wed that the spontaneous fermentation method was first used in China. Blomberg (1932) described this process as consisted of allowing the egg white to ferment in wooden sakes. The fermentation time would take from 36 to 60 hours at room temperature. He added that the Scum, which

consists of the mucin along with some mucoids, come to the top and thin white accumulates at the botton of the tank. Samples were taken periodically for glucose determination.

During the experimental fermentation of Stewart and Kline (1941), they stated that the bacterial count of the product rose from less than one thousand per gram to two hundred million per gram. Stewart and Gorsline (1942) found that sugar could be depleted from egg white by permitting a spontaneous fermentation to take place. The bacteria present were usually of the genera Aerobacter and Escherichia. On the other hand they found that in the long incubation period, ordinarily employed (2.7 days), the product developed sufficient acidity to precipitate the mucin. Moreover, they added that during the stages of fermentation putrid edours and proteolysis also were evident. Besides Salmonella thrived in the albumen and presented a health hazard. In the presence of Proteus, Serretia, and Pseudomonas a dull, dingy and amorphous product was obtained upon drying. They also reported that pure culture fermentation by coliform organisms yielded albumen of good quality.

Various other types of bacterial fermentation for egg whites have studied by Stewart et al. (1943), Harris (1949) and Kaplen et al. (1950). The experimental results of Ayres (1958) indicated that glucose could be removed from egg albumen by using Saccharomyces cerevisiae, Streptococcus lactis, and Aerobacter aerogenes. Fermentation by these organisms could be successfully completed in 4.52 - 5.5 hours by incorporating 0.1 % yeast extract. Charles (1967) found that sugar could be eliminated from egg white by inoculating the liquid with Aerobacter and leaving it to ferment 6 hours at 35.6°C. He added that Somogyi test for reducing sugar was carried on the fermented albumen until the sugar content reached zero. After the fermentation process, egg albumen was cooled to 10°C, and spray dried to a moisture content of 7 %. He found that the total bacterial count was reduced from 10^9/gm in case of fresh liquid egg albumen to 390/gm in case of packaged egg white, and Salmonella count was reduced from 1.5 to 0.03org./gm. Moreover, the dried albumen when used in baking had the same baking quality as fresh albumen in texture, body, and height of rise of cake.