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ALTERNATIVE FOR PROTEIN CONCENTRATIONS OBTAINED FROM EGG WHITE BY COLD DRYING

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Abstract

This paper presents an alternative method to dry white eggs. Because on thermal treatment the protein denaturation is relatively high, cold drying of the white eggs maintains intact the protein chain. Eliminating the air heating from classic technology will conduct to energy reducing during the process. Also, all products, made of the white egg powder obtained using cold draying, will have complete proteins in amino acids.

***Key words*:** *protein, egg white, cold dry*

INTRODUCTION

Drying is one of the oldest unitary operations, it is the operation that reduces the water content. Drying is achieved until the storage moisture content of the product is reached.

Drying is accomplished by evaporating the water which gradually reaches the surface of the product to be dried to aw <0.7 which prevents the development of microorganisms [12].

Natural materials and manufactured products contain variable proportions of moisture, coming from contact with liquid water or atmospheric vapors [11].

Drying is the operation by which water from solid or liquid materials is removed by air, which has a double role: to bring the heat needed to vaporize the water and to evacuate the resulting water vapor by heating [1,6].

The main reason for drying the food is to extend the shelf life. Also, the enzymatic activity and the speed of unwanted reactions are reduced accordingly.

The main methods of dehydration are: natural drying, directed dehydration in special installations at normal pressure, fluid bed dehydration, vacuum concentration, lyophilization (cryodication or cryosublimation) [8,13].

The most modern methods are fluid bed dehydration and lyophilization, the latter ensuring the rehydration capacity, preventing oxidative processes and reducing the smell, taste and aroma to a lesser extent [2,9,10].

Dehydrated products have a reduced volume, lower weight, increased energy value, are easy to prepare, save on storage and storage, are easy to handle and transported, but lose some of the aromatic substances and partially destroy some vitamins [5].

Pre-fluidized food products are dehydrated by two methods: pellicular and spray or powder atomizer (egg powder, powdered milk, etc.).

White egg consist almost entirely from water (78%) and protein (11-12%). To this is added reduced amounts of fat (0.2%), carbohydrates (0.9-1.9%), mineral salts, enzymes and vitamins.

With proteins of high nutritional value, dehydrated egg white can successfully replace milk protein concentrates widely spread in the market.

Moreover, the process proposed in this paper reduces production costs and, implicitly, the price of the final product.

Also, in the absence of oxygen in a cool storage environment, powdered eggs have a storage life of 5 to 10 years [13]. Consequently, in the absence of yolk, the shelf life is even more guaranteed.

MATERIALS AND METHODS

The device is made up of two vertically connected compartments communicating with each other through two end slots.
The lower compartment includes the fans and the support on which the white is dispersed.
The upper compartment is identical in shape to the lower one, with the difference that at the extremities there are two transverse slots allowing the passage of the air flow [3].
At its bottom, there is a grate that holds the silica gel powder adsorbent layer compact.
Principally, as seen in Fig. 1, the operation of the apparatus is based on forced air circulation through the two compartments.
The three fans, arranged to transversely cover the whole section of the lower compartment, take up the air passing through the corresponding slit in the upper compartment, and direct it to the egg white to be dehydrated.
This is amplified by the inclined arrangement of the fans so that the air currents move to its surface, vaporizing superficially water from the surface of the white layer.
This vaporization has therefore the water flow from the base of the layer to the surface.
The air whose relative humidity increased by taking up a quantity of water from the surface of the white leaves the lower compartment [7] through the slot opposite the one that feeds the fans and penetrates the upper compartment [4].
Here the air currents will move sharply with the silica gel layer due to the positioning of the slots at the base of the compartment.
Humidity taken over by the air will be adsorbed by silica gel.
The dry air will continue its movement by resuming the circuit.

RESULTS AND DISCUSSIONS

Sizing device calculation

In the sizing calculation, 100 cm^3 of workmanship shall be considered.
pound = 1.03 g / cm3

Dissipation surface:

$$Ssp = 21 \times 29.7 = 623.7 \text{ cm}^2$$

For 100 cm^3 of egg white, the height of the layer is:

$$hrs = 100 / 623.7 = 0.16 \text{ cm}$$

The amount of water in 100 cm^3 of egg white:

- 100 g of white contains 88 g of water
- 100 cm^3 contains lighter x 88 = 1.03 x 88 = 90.64 g water

Theoretically, 100 g of egg white yields 12 g of dry white
Considering that silica gel has a high after adsorption capacity of up to 35-40% of its own dry mass, it was considered that to extract 88 g of water from the egg white dissipated on the support of 623.7 cm^2 is need:
dry white oil = m white/0.35 = 90.64/0.35 = 258.97 g
Standard silica gel has an apparent density of 730 kg/m^3 (0.73 g/cm^3)
The volume of silica gel required to adsorb 88 g of water is:
Dry silica gel = 258.97/0.73 = 354.75 cm^3
Necessary absorption area considering the dissipate layer thickness of max 0.5 cm:
Sabosorption = 354.75 x 2 = 709.51 cm^2
For air circulation, 3 Evercool EC9225HH12X (Figure 2), fans are coupled to a speed variator for airflow control.
The fan parameters are:
Number of rotations: 3,000 rotations/minute
Voltage: 12 V
Intensity: 0.3 A
Air flow rate: 1.7 m^3/min

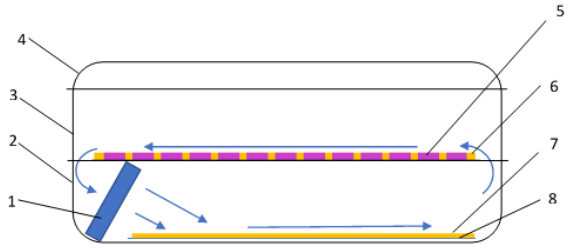

Fig. 1. Scheme of adsorption desiccation system in silica gel
Legend: 1. Ventilator;
2. The lower body of the appliance;
3. Upper body;
4. Cover;
5. Silica gel;
6. Uniform grid distribution of silica gel;
7. Eggplants;
8. Flexible support.

Three drying processes at 24 °C (laboratory ambient temperature) and 3 freeze-drying processes at 5 °C of 100 cm^3 of egg white were performed.

The relative humidity at the air intake air gap was measured at the fans. The drying times are presented in Table 1.

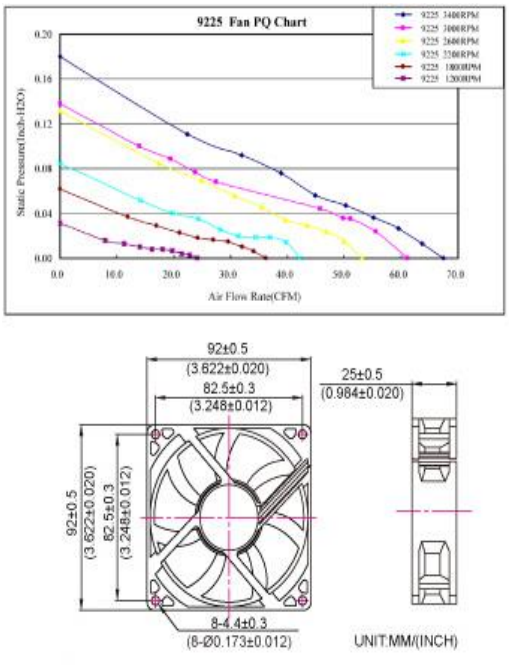

Fig. 2. Evercool EC9225HH12X

Table 1. Drying times correlate with working temperatures

Temperature [°C]	Drying 1 [min]	Drying 2 [min]	Drying 3 [min]
24	65	68	66
5	59	58	60

Dehydrated albumin was obtained by scraping the support on which the white was dispersed. The theoretical amount of dehydrated egg white is 12.36 g.

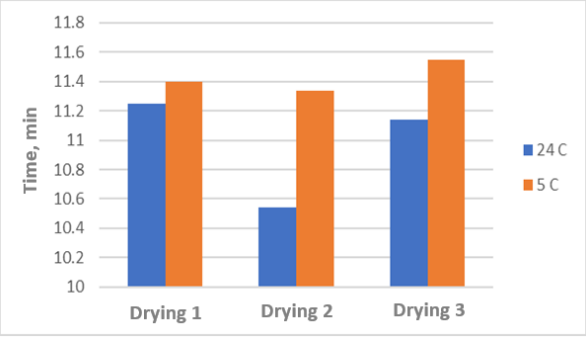

Fig. 3. Dehydration time

Table 2. The amount of dewaxed white powder obtained

Temperature [°C]	Drying 1 [g]	Drying 2 [g]	Drying 3 [g]
24	11.25	10.54	11.14
5	11.4	11.34	11.55

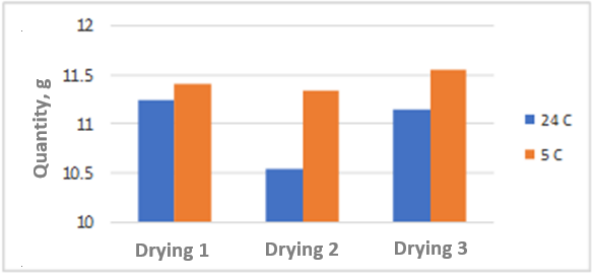

Fig. 4. The amount of dewaxed white powder obtained
Source: Kudra, T., & Mujumdar, A.S. (2001). Advanced drying technologies. Marcel Dekker Inc. New York

CONCLUSIONS

The technology based on fluid bed dehydration due to the use of high temperatures for dehydration leads to protein denaturation.
The process presented in this paper prefers this, the whole process taking place at low temperatures.
Based on the experimental data and the model presented, an industrial high-capacity drying plant can be dimensioned.
There were no references to the exhalent of a configuration like that presented in the paper.
The experiments were carried out on white chicken. The following research will also target other bird species.
Also, the degree of denaturation of proteins in both the oxygen atmosphere and in different gases that do not affect the protein structure should be evaluated.

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