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Research Article

The Effect of Some Chemical Additives on the Foaming Performance of the Pasteurized Liquid Egg White

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Abstract

The foam stability ranged between 46.7 (0.5 mg/kg phospholipase.24h) and 64.6 (0.5 mg/kg phospholipase.48 h). When tartaric acid is added to egg white in the rate of 5 %, an increasing in foam capacity and stability were observed. In the use of sodium acid pyrophosphate (SAPP), especially on performance effects, it was seen that the similar results to citric acid and tartaric acid were obtained. In Control Group 1, while the effect on foam capacity was 200 units, due to the fact that it does not form cream of lump of dough. In Group 2, whose contamination of egg yolk is low, it was seen that it was only 40 units. In the rates of tryethyl citrate of 0.1 -1 ml/kg, in the studies on two different control group, in pH and brix, any variation was not observed. In foam capacity, the values between 640-690 were identified and in stability, the values ranging 60.3-67.4. It is considered that the rate of maximum using was around 0.2 ml/kg. Triethyl citrate protects egg white against the detrimental effects of egg yolk.

Keywords: Egg whites; Foamming; Food addivites; Performance of egg white

Introduction

Eggs are used in the preparation of many food products. The most well-known uses of eggs are based on the liquid eggs coagulate or solidify when heated (cakes, breads, crackers); whipping of egg white produces lighter and airier products (meringues, angel cake); and emulsifying egg yolk phospholipids and lipoproteins produces mayonnaise, salad dressing and sauces [1]. A foam is a colloidal dispersion in which a gaseous phase is dispersed in a liquid or solid phase. Food foams are dependent on the surface activity and film forming properties of specific protein components [2]. Many proteins are too hydrophobic or too hydrophilic for good foaming properties, and so chemical or enzymatic modification of them makes them more surface active. Foaming agents generally used in the food industry are modified natural proteins of soy, casein, egg white, whey, whey protein isolate lactoglobulins, lyzosyme [3-7]. Protein film stability and elasticity vary due to the fact that proteins consist of different amino acids so that different intermolecular interactions ocur [5,7]. Hen eggs are very well known foaming ingredients. They produce large volume, stable foams which coagulate during heating. When egg white was beaten, air bubles were trapped in the liquid albumen does. During the beating of egg white, the air bubbles, decrease in size and increase in number, and the translucent albumen takes on an opaque but moist apperance. As increased amounts of air are incorporated, the foam becomes stiff and loses its flow properties [8]. Overwhipping insolubilizes too much of the ovomucin and lowers the elasticity of the bubbles [9]. If the first foam is beaten for a long period, the darinage liquid exhibits poor whipping properties [10]. The greatest amount ovomucin is removed with the first whipping [9] but about one third of the ovomucin can be recovered form the drainage after the third whipping [11]. In addition to ovomucin, lysozyme, globulins A1 and A2 and conalbumin are retained in the foam [11]. The structure of egg albumen allows it to perform well in foams and each component carries out a different function [12]. Globulins are excellent formers but the foaminess is significantly affected by the protein interactions with ovomucin, lysozyme, and, to a lesser extent, ovomucoid, ovotransferrin, and ovalbumin [13]. The aim of this study is facing the egg whites industry, the biggest problem is yolk-white distinction, during the egg yolk with contamination as a result of decrease foam capacity and stability, to investigate the food additives that may be used for improvement.

Materials and Methods

Material

Pasteurized egg whites were provided from ANAKO Liquid Egg Industry in Konya in Turkey. Pasteurized egg whites were used in the study for because of hygiene.

Method

Different properties are different batch production reference egg whites are used for each additive and at different times because of the realization of the trial, the control group showed changes as a result of egg whites. Two different control group has been compared result for each additive.

Relative whipping capacity

Kitchen Aid Professional sample is taken and transferred to the mixer. 6th cycle in the mixer for 1 minute, blended for 2 minutes at the 10th cycle. After the beating, the foam formed is transferred to measuring cup to 1000 ml. Leaves no residue in the mixer vessel is attempted whenever possible [14]. For measuring, sample was heated to 20 °C.

Foaming capacity relative reading of the following formula

$$\%RWC = V \times 100/75$$

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Table 1: Effect of phospholipase enzyme on egg white performance at different times.

Samples	pH	Brix(%)	Foam Capacity(%)	Foamstability(%)	Heigh of meringuecrema(cm)
Control	8.9	14.1	513	51.7	-*
0.25 ml /kg phospholipase 24h	8.9	14.1	1066	54	7.3
0.25 ml/kg phospholipase 48h	8.9	14.1	1066	54.7	7.5
0.5 ml/kg phospholipase 24h	8.9	14.1	1100	51	7.9
0.5 ml/kg phospholipase 48h	8.9	14.1	1113	56,4	8.3

Table 2: The effect of tartaric acid on egg white performance at different times.

Samples	pH	Brix(%)	Foamcapacity(%)	Foamstability(%)	Heigh of meringuecrema(cm)
Control 1	8.8	13.8	659	56.2	7.7
1% cream tartar	8.33	14	720	65.7	8.1
3% cream tartar	7.5	14.1	700	70.9	6.7
5% cream tartar	7	14.1	770	68.8	7.1
10% cream tartar	6.3	14.2	713	66.7	6.3
12% cream tartar	5.8	14.3	650	64.5	7.4

Table 3: The effect of sodium acid pyrophosphate on egg white perfornanceat different times.

Samples	pH	Brix(%)	Foamcapacity(%)	Foamstability(%)	Heigh of meringuecrema(cm)
Control 1	8.9	14	533	44	-*
0.6% SAPP	8.7	14	533	52	-
1% SAPP	8.6	14	626	68.6	6.2
3% SAPP	7.9	14	683	57.8	6.2
5% SAPP	7.5	14	608	46.8	6

*cremadid not form

Determination of whipping stability

Foam do not fall, after measuring whipping capacity, and at the end of an hour amount of leakage weigh and calculated whipping stability by the Formula:

S: Whipping stability

%S= (1 - W/77,25) x100

Measuremet of pH and brix

pH measurements will be used in table-top type device. Device is calibrated by the buffer solutions for 4.01, 7.0 and 10.0. pH meter probe is pressed into the sample immersed in pH measurement button and wait 40 sec. After measuring the pH value is recorded as time runs out on the screen. For brix, refractometer at 20 ˚C the calibration is done with distilled water. The prepared egg white samples were incubated in a warm water bath until 20 ˚C. Heated read the refractometer taken with a little spatula to 50 ml sample. Reading sample is brixs% [9].

Meringue dough performance

200 ml egg white's samples is heated at 20 ˚C . 200 g is provided to dissolve by the addition of sugar. Taken mixer. Blending sugar and egg white mix to 4th cycle for 1 min and 10th cycle for 4 minute . After blending , caliper measurement is taken from the high portion of non-container mixer. So, merinque dough performance measured [15].

Results and Discussion

Effect of phospholipase enzyme on egg white perfornance at different times are given in Table 1. With addition of phospholipase to the environment, there were not any important deviation in pH and Brix (Table 1). In term of the capacity of foam, an important increase occurred in those treated compared to the control (Table 1). In Brix, an important variation was not seen, and it was considered that the decrease of 0.2 units in the first control group may be related to the precision of instrument [15]. The highest foam capacity was identified in the sample with addition of 0.5 mg of phospholipase for 48 hours (Table 1). It is considered that this increase may probably be due to protein interaction. When regarded to the foam stability, it was seen that there was a fluctuation depending on the concentration of enzyme added and the time. In general, foam stability ranged between 46.7 (0.5 mg/kg phospholipase for 24h) and 64.6 (0.5 mg/kg phospholipase for 48 h). When the height of lump of dough compared to the control, an important increasing was observed, and maximum height of lump of dough became 9.3 (0.5 mg/kg phospholipase for 48 h). At the beginning, egg white having a foam capacity of 1200 mg/100 g, with addition of egg yolk of 0.3%, it was seen that foam capacity regressed to 300 ml/100 g and that phospholipase enzyme, added at the rate of 200 ml/ton, rearranged the foam capacity at 0-4 ˚C and improved it at the levels of 1200 ml/100 g. Again, in foam stability, it was observed that pure egg white of 87 ml/ 60 min with contamination of 0.3% egg yolk, regressed to 35 ml/60 min, and with phospholipase enzyme, that there was again an improvement at the levels of 80-85 ml/60 min. While 50 units of improvements in stability were provided and 900-1000 units in foam capacity, in this study, the amounts of improvements remained at lower levels. As the reasons for this, it was considered that the foam capacities and stabilities were

Table 4: The effect of citric acid on egg white perfornance at different times.

Samples	pH	Brix(%)	Foamcapacity(%)	Foamstability(%)	Heigh of meringuecrema(cm)
Control	13	8.92	1000	54.6	6.9
0.1% citric acid	12.4	7.14	1133	68	7
0.3% citric acid	12.8	6.03	1200	69	6.8
Control 2	13.4	9	720	45.2	-*
0.1% citric acid	13.4	7.4	760	48.6	-
0.3% citric acid	13.4	6.4	640	51.6	-

*cremadid not form

Table 5: The effect of triethyl citrate on egg white perfornance at different times.

Samples	pH	Brix (%)	Foamcapacity(%)	Foamstability(%)	Heigh of meringuecrema(cm)
Control	9.1	14.1	666.5	60.6	6.5
0.1 ml/kg triethyl citrate	9.1	14.1	715	62.9	6.5
0.2 ml/kg triethyl citrate	9.1	14.1	825	64.5	6.7
0.5 ml/kg triethyl citrate	9.1	14.1	715	63.9	6
1 ml/kg triethyl citrate	9	14.2	700	64.2	6

low; and that contamination of egg yolk was higher than the study we made a comparison. In addition, it was thought of that this would result in low improvement rates.

On condition that the content of egg yolk is kept at a certain level, when tartaric acid is added to egg white in the rate of 5 %, an increasing in foam capacity and stability were seen (Table 2). In the uses over 5%, also with the effect of increasing acidity, the losses were again seen in the foam values. In view of this, in the uses of cream of tartar, it is considered that pH should be lowered below the levels of 7-7.5. In addition, in egg whites, whose the concentration of egg yolk is high (Control Group 2), it did not show any effect on lump of dough performance and it was seen that the formation of cream of foam could not possibly be provided. In heated white egg, by using lactic acid, hydrochloric acid, or potassium acid tartrate (tartaric acid), it was reported that pH should be kept around 6.0- 6.5. However, due to leakage in “lump of dough” product, reducing a beaded structure forming near it cannot be provided by potassium acid tartrate. About the quantity of the use of potassium acid tartrate /tartaric acid), also in our study, pH related literature results were reached. In egg white having the rate of 10%, determined at pH 6.12, some decreases occurred in foam capacity, foam stability, and the height of cream of lump of dough, which are performance values.

In the use of SAPP, especially on performance effects, it was seen that the similar results to citric acid and tartaric acid were obtained. Again, if the first performance of control group at a certain level, some improvements were observed; otherwise, it was seen that it did not have any positive effect on cream of lump of dough but considerable increase in the values of stability and foam was not observed. For being able to obtain maximum result, maximum rate of use should be around 3% (Table 3) due to the fact it is an acidic agent, pH ranges in a wide range.

In the use of citric acid, that important effect on foam capacity can be provided on condition that the content of egg yolk is kept at a certain levels. In Control Group 1 having low contamination, while the effect on foam capacity was 200 units, due to the fact that it does not form cream of lump of dough, in Group 2, whose contamination of egg yolk is low, it was seen that it was only 40 units (Table 4). For increasing foam properties of duck egg, lemon juice was used. Apparently, it was seen that, addition of acid, influencing ovomucin, reduced whisking time. In angel cake, made with acid added duck egg, it was seen that a better result was obtained compared to that made with chicken white egg white. Acid increases the internal brightness of cake and acid and acid salts develop stability. In addition, acid and acid salts develop foam stability of albumin. Also in our study, in Control 2, while foam capacity falls with the amount of citric acid that increase, it was seen that there was an increase in foam stability. Again, in Control 1, while height of cream of lump of dough falls, seeing that there was not any decrease in stability and that acid has an effect increasing the stability, an equivalent result to literature was obtained.

In the rates of tryethyl citrate of 0.1-1 ml/kg, in the studies on two different control group, in pH and brix, any variation was not observed but its positive effects was seen on the performance criteria. In foam capacity, the values between 640-690 were identified and in stability, the values ranging 60.3-67.4. It is considered that the rate of maximum use was around 0.2 ml/kg (Table 5). Triethyl citrate protects egg white against the detrimental effects of egg yolk. While it reduces whisking time in white eggs that contains yolk or not, its detrimental effect on cake was only seen as increase of cake volumes made with white egg containing egg yolk. As indicated in the literature, also in our study, it was seen that triethyl citrate provided improvement in even Control 2, whose contamination of egg yolk is high. In foaming agents such as citric acid and SAPP, since cream of lump of dough did not form, in white eggs, in which it is considered that it contains high yolk contamination, while the desired improvement cannot be provided, triethyl citrate, even if its cream height is low, it is possible for it to form a firm cream. In the other additives used, while improvements in control group shows a variability compared to the beginning concentration and the amount of egg yolk contamination, in NaOH, these variabilities were not seen in the considerable rates, as the quantity increases, improvement actualized significantly [15].

Conclusion

In our study, a result supporting literature was observed. In the study specified above, the stability and foam capacity was mentioned about. Also in our study, it was seen that even in egg whites having high concentration, the desired improvement was provided.

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