As. J. Food Ag-Ind. **2012**, 5(05), 440-447

OPEN ACCESS

Asian Journal of Food and Agro-Industry

ISSN 1906-3040

Available online at www.ajofai.info

Research Article

Some factors influencing the quality of salted quail eggs

Quoc Le Pham Tan, Oanh Nguyen Tran Thi Hoang and Tam Ngo Thi Thanh

Institute of Biotechnology and Food Technology, Ho Chi Minh City University of Industry, Ho Chi Minh City, Vietnam.

Email: lephamtanquoc@yahoo.com

Abstract

The raw materials used in this study are fresh quail eggs. The purpose of this study is to conduct research into optimal factors for egg preservation in a salt solution in a laboratory environment. Results obtained: optimum soaking time is 25 days, optimum salt solution strength is 26%, the optimum ratio of eggs/salt solution was 50 eggs/500ml. Salted eggs have a transparent egg white, colloidal state, concentrated, egg yolk is yellow or red. Salted eggs had characteristic flavour and taste and were found acceptable by a tasting panel. Using this method to provide longer shelf-life can result in this food source becoming more popular and being distributed more widely.

Keywords: *Coturnix japonica*, poultry, osmosis process, brine solution, sensory evaluation, Vietnam.

Introduction

Eggs play an important role in human nutrition as they contain many nutrients and vitamins. They are used in daily life, as well as the agriculture and the food technology industries. There is an uneven egg yield throughout the year, so eggs need be preserved for distribution to consumers. So the problem of harvesting and preserving eggs is very important, especially affecting the daily nutrition of people and efficiency of the economy [1].

The price of each quail egg is equal to $1/6^{th}$ to $1/5^{th}$ the price of a chicken egg. In addition, content of vitamin (A, B_1, B_2) and some micronutrients in quail eggs is higher than chicken eggs [2]. Salted quail egg is a relatively new product in Vietnam, can be preserved for a long time, easy to use and the taste is appreciated by Vietnamese consumers [3, 4]. Quail are regularly raised in South East Asia as a source of both meat and eggs [5]. Some research is now being conducted on new developments in processing [6], therefore, this research was conducted to examine some of the factors that influence salted quail egg quality.

Materials and Methods

Materials

Fresh quail eggs (*Coturnix japonica)* were purchased from Ba Huan Co. Ltd. in Ho Chi Minh City and sorted based on size (2-2.5) x (3-3.5) cm, average weight 10 – 12g/egg, black colour without any signs of strange flavours and breaks. Soaking water was purchased from Bidrico Company, pH ~ 6.6 and dried salt purchased from Salt Cooperative Tien Thanh, Can Gio District, Ho Chi Minh City.

Equipment

Instron 5543 mechanical tester (speed of 5 mm/s, diameter of sensor 3mm, USA), pH meter EcoTestr pH2 (Malaysia) and Atago photorefractive 0-32^{o}Brix (Japan).

Methodology

Quail eggs were cleaned on their surface by salt solution 10%. Then they were put into a glass pot to soak in salt solution strength was 23%, 26% and 29%. The ratio between eggs/salt solution was 50 eggs/500ml. Eggs were in salt solution for 22, 25 and 28 days at 28-30^{o}C.

Texture analysis method

The Instron 5543 was used to measure the hardness of egg shells, with a speed of 5 mm/s.

Sensory evaluation

The sensory evaluation of consumers was applied for the preserved quail eggs. Sixty panellists evaluated the sensory attributes of the eggs. Panellists were given no time limit for the evaluation, though most panellists took 10-15 min to complete the rating of all the samples. Quail eggs were boiled and cut into small pieces and placed on a plastic plate with a random number. The attributes evaluated were colour, flavour, texture and overall acceptability. For each sample, panellists scored their liking of these characteristics using a five-point hedonic scale (1 = dislike very much, 2 = dislike slightly, 3 = neither like nor dislike, 4 = like slightly, 5 = like very much) [7].

Statistical analysis

Data were analyzed in triplicate and subjected to the analysis of variance (ANOVA) using the Statgraphics Centurion XV software package. Significant differences ($P < 0.05$) among group means were calculated with the LSD's multiple range test [8].

Response surface methodology (RSM) was used to determine optimum conditions for this research [9]. The effect of two factors, soaking time and the content of salt solution to the Brix of the soaking solution (y_1), salt concentration of quail egg after soaking (y_2) was defined by using the Mohr method [10].

Influence of factors to target function were described according to second-level model with the equation below:

$$y = b_o + \sum_{i=1}^{n} b_i x_i + \left(\sum_{i=1}^{n} b_{ii} x_i \right)^2 + \sum_{i<j}^{n} b_{ij} x_i x_j \quad (1)$$

In this study, n-value was 2 so equation (1) can be written:

$$y = b_o + b_1x_1 + b_2x_2 + b_{12}x_1x_2 + b_{11}x_1^2 + b_{22}x_2^2 \quad (2)$$

A 2^3 three level Central Composite Face-Centered (CCF) was used to develop a statistical model for the optimization of process variables such as rate of salt solution (23-29%) and soaking time (22-28 days). The design contains a total of 12 experimental trials with a full factorial design fashion and the replications of the central points. Data obtained from RSM on essential oil production were subjected to the Analysis of Variance (ANOVA) and analyzed using a second order polynomial equation by the software Modde version 5.0

Table 1. Codes and actual levels of the independent variables for design of experiment.

Independent variables	Symbols	Coded levels		
		-1	0	+1
Rate of salt solution (%)	x_1	23	26	29
Soaking time (day)	x_2	22	25	28
y: Salt concentration in quail egg (g/kg)				

Factors b_o, b_1, b_2, b_{12}, b_{11}, b_{22} were determined by the experiments. Statistical significance of the regression coefficients were determined by t - student test. The regression of quadratic equation is determined based on Fisher test. Relevance and predictability of the regression model is expressed through R^2, Q^2 value. Optimum conditions of processing are determined by Modde5.0 software based on CCF method (Central composite face-centered).

Results and Discussion

Regression of equation of the salt concentration in quail eggs

The levels of salt concentration were determined as shown in Table 2, while ANOVA results can be seen in Table 3.

The p_{value} was used as a tool to check the significance of each of the coefficients, which in turn indicated the pattern of the interactions between the variables. The smaller value of p was more significant to the regression. According to the ANOVA table, the regression model is significant at the considered confidence level (95%) since the regression has $p_{value}<0.05$.

Table 2. Three level factorial composite design and experimental responses of dependent variable y (Salt concentration in quail egg, g/kg).

Run No.	Coded levels		Real values		Salt concentration in quail egg
	x_1	x_2	X_1	X_2	y
1	-1	-1	23	22	21.4
2	+1	-1	29	22	35.25
3	-1	+1	23	28	28.74
4	+1	+1	29	28	44.65
5	-1	0	23	25	23.31
6	+1	0	29	25	35.45
7	0	-1	26	22	25.79
8	0	+1	26	28	31.14
9	0	0	26	25	31.09
10	0	0	26	25	33.88
11	0	0	26	25	31.43
12	0	0	26	25	32.1

Table 3. Analysis of variance (ANOVA) for the fitted quadratic polynomial model for salted quail egg.

y	DF	SS	MS	F	p_{value}	SD
Total	12	12087.7	1007.31			
Constant	1	11670.7	11670.7			
Total Corrected	11	417.037	37.9125			6.15731
Regression	5	376.123	75.2247	11.0317	**0.006**	8.67322
Residual	6	40.9136	6.81894			2.61131
Lack of Fit	3	36.2787	1.21E+01	7.82729	0.062	3.47749
Pure Error	3	4.6349	1.54497			1.24297

Table 4. Results of regression analysis of second order polynomial model for optimization of content of salt in quail egg.

y	Coeff.SC	Std.Err	p_{value}	Conf. int(±)
Constant	30.9933	1.19189	2.1332e-0.07	2.91648
x_1	6.9833	1.06606	0.00060	2.60858
x_2	3.68167	1.06606	0.01357	2.60858
x_1*x_1	0.64999	1.59909	0.69849	3.91287
x_2*x_2	-0.26499	1.59909	0.87382	3.91287
x_1*x_2	0.51499	1.3056	0.70689	3.19385

N = 12	Q^2 = 0.346	Cond. no. =	3.1260
DF = 6	R^2 = 0.902	Y-miss =	0
$R^2_{Adj.}$ = 0.820	RSD = 2.6113	Conf. lev. =	0.95

Rate of salt solution (%) and soaking time (day) are absolutely independent and do not interact together ($p_{value} > 0.05$) and have strong influence to salt concentration in quail egg.

Regression equation presents dependence of salt concentration on two factors quoted above as follows:

$$\mathbf{y = 30.9933 + 6.98333*x_1 + 3.68176*x_2}$$

It is shown that the regression coefficients of linear term X_1, X_2 were significant at < 1% level and none - interactive coefficient of $X_1{}^*X_2$ were significant at > 5% level. The p_{value} was used as a tool to check the significance of each of the coefficients, which in turn indicated the pattern of the interactions between the variables. The smaller value of p was more significant to the corresponding coefficient.

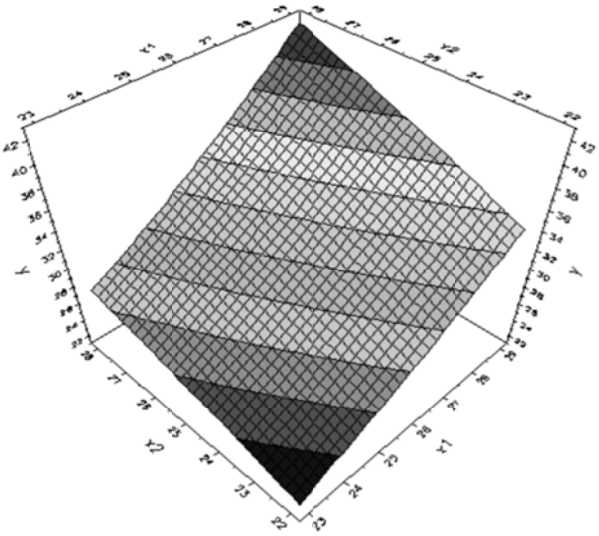

Figure 1. Response surface plot of rate of salt solution versus soaking time.

Regression of equation reflects the accuracy of empirical model and this was confirmed by R^2 value, the accuracy 90.2%. Predictability of the model represented by the compatible model Q^2 with reliability is 34.6%. The regression coefficients of linear were rate of salt solution and soaking time that made to change the content of salt in the egg (the influence of salt solution is the strongest). Regression of equation does not have the regression coefficients of quadratic. Osmosis process was optimal when y (salt concentration in the egg) was increased then x_1 (salt solution) was high and x_2 (soaking time) was increased.

However, this process depended on the chemical and physical factors and sensory results. x_1 can only increase up to 29% because the concentration has reached saturation and x_2 can only increase up to 30 days because the quite salty egg, on the other hand can be damaged by the phenomenon of nutrient diffusion of solutes in water and soaked egg shells are very soft and fragile after the preservation process. Thus the variable x_1, x_2 is only varying within the range of the experiment.

Sensory evaluation of quality of salted quail egg

Sensory evaluation of the salted eggs followed consumer tests with a combination of nine samples (five point scale).

Table 5. Overall acceptability score of sensory test.

Content of salt in soaking water / Soaking time	23%	26%	29%
22 days	1.5±0.3[a]	2.5±0.2[b]	1.6±0.4[a]
25 days	1.6±0.4[a]	4.2±0.2[d]	2.4±0.4[b]
28 days	2.7±0.2[b]	3.7±0.2[c]	2.6±0.2[b]

Different superscript characters indicate significant difference ($p_{value} \leq 5\%$)

The sample with salt concentration in solution of 26% and soaking time of 25 days to reach the optimal point (4.2 points) and statistically significant ($p_{value} = 0.03$). Therefore this rate was chosen for the next research.

Hardness of egg shell

As can be seen from Figure 2, the more the eggs were soaked in the salt solution, the more the egg shells became porous, soft and fragile. This is due to the osmotic effects of salt that eroded the egg shell, making the skin more porous. In addition, the minerals inside the egg shell will escape into the salt solution made the skin become softer.

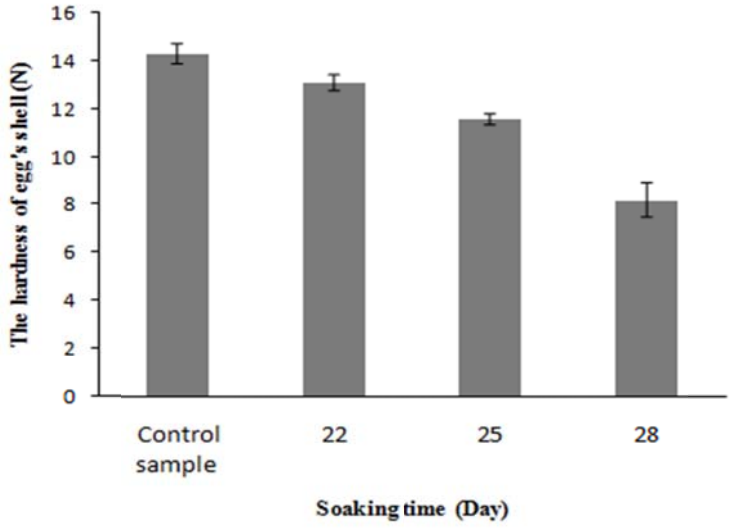

Figure 2. Effect of soaking time on the hardness of egg shells.

Conclusion

From the result of this study, equation of regression is written:

$$y = 30.9933 + 6.98333*x_1 + 3.68176*x_2$$

With a soaking time of 25 days and salt concentration of solution of 26%, salted eggs have sufficient sensorial quality that the textural consistency, colour and flavour was pleasing to consumers. Therefore it is recommended that salted eggs from quail as a viable means of preservation has potential to improve the consumption of this source of nutrition as an alternative to hen's eggs.

Acknowledgement

The authors gratefully acknowledge the Institute of Biotechnology and Food Technology, Ho Chi Minh City University of Industry for providing necessary facilities for the successful completion of this research work.

References

1. Bao Nguyen Chi (1990). Biological basis of breeding and raising poultry. Science and Technology Press. Ho Chi Minh City (in Vietnamese).

2. Long Dao Duc (2002). Biology of varieties of poultry in Viet Nam. Science and Technology Press. Ho Chi Minh City (in Vietnamese).

3. Angalet, S.A., Wilson, H.R. and Fry, J.L. (1976). Acceptability of Pickled Quail Eggs. ***Journal of Food Science,*** 41(2), pp 449-450.

4. Trongpanich, K. and Dawson, L.E. (1974). Quality and Acceptability of Brine Pickled Duck Eggs. ***Poultry Science,*** 53(3), pp 1129-1133.

5. Ikhlas, Boni, Huda, Nural and Ismail, Noryati (2010). Comparison of meat quality characteristics of young and spent quail. ***Asian Journal of Food and Agro-Industry,*** 3(05), 498-504**.**

6. Panda, B. and Singh, R.P. (1990). Developments in processing quail meat and eggs. ***World's Poultry Science Journal,*** Vol. 46, November.

7. Dung Nguyen Hoang (2008) Sensory evaluation of food. Ho Chi Minh City University of Technology Press. Ho Chi Minh City (in Vietnamese).

8. Tuan Nguyen Van (2008). Analyze data and plot by R. Viet Nam National University-Ho Chi Minh City Press. Ho Chi Minh City (in Vietnamese).

9. Natrella, Mary, Croarkin, Carroll and Guthrie, Will (2003). Engineering Statistics Handbook. Statistical Engineering Division, NIST2003.

10. Mai Dam Sao, *et al*. (2008). Food Analysis Textbook. Ho Chi Minh City University of Industry Press. Ho Chi Minh City (in Vietnamese).