Research on Optimization of Production Process of Whole Egg Liquid Egg Dry

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Abstract. In order to improve the egg processing technology innovative applications, this paper researches the main raw material according to the liquid whole egg, cooking experiments made instant food. Hardness, gumminess, cohesion, viscous, chewiness and elastic as measure indicator, and combined with sensory score, the effects of carrageenan, water, cooking time and cooking temperature on the impact of eggs dry matter were determined. On the basis of single factor experiment, orthogonal experiment was carried out. Results showed that the optimal formula was carrageenan 0.4\%, water 20\%, cooking time 15 min, cooking temperature 120 \textdegree C. Under this condition, the sensory score was the highest.

Introduction

Egg is one of food which human being eats frequently, not only it contains rich high quality protein and lipid, but also provides people with vitamins and minerals \cite{1}. The nutrition of the egg is the essential part of the body, it plays an extremely important role, such as repair tissue, formation of new tissue, energy consumption, and involved in the metabolism of complex process, etc. Egg yolk contains rich lecithin, it can decrease the cholesterol, soften the blood vessels, decrease the blood pressure and improve the memory effect \cite{2-4}. And the digestion rate of egg’s high quality protein is as high as 98\%, it is the highest among the milk, meat, rice, bread and other food \cite{5-6}. The traditional eating way is mainly limited to fried, steam, boil and other cooking ways, and processing marinated egg, salt egg, preserved egg, and other products, so that they have poor taste and nutrition \cite{7}. In recent years, with the progress of food industry technology and the innovative application of the processing technology, the new type of processed products egg dry gets the favour of consumers due to it’s easy to eat and carry, delicate taste, long shelf life, product novelty and other characteristics \cite{8}.

Materials and Methods

Experimental Materials

Egg (Wal-mart, Changchun), water, salt, sugar, carrageenan, soy protein, white pepper, ginger, onion juice are all of food grade.

Instrument and Equipment

Air-cooled freezers (Sartorius Co., Ltd, Beijing); electronic balance (Sartorius Co., Ltd,
BAS124S-CW, Beijing); V8 vacuum packaging machine (Taiwan well-off machinery Co., Ltd.); TMS-Pro Texture Analyzer (US FKC Co., Ltd); Universal chopping machine (Stephan Co., Ltd).

Test Content and Method

**Basic Formula.** (whole egg liquid: soy protein 20:1, salt 3%, sugar 1.2%, white pepper 0.2% , ginger juice 1%, onion juice 0.8% )

**Operation Process.** Raw material → cleaning → shell breaking → additive → mixing → filter → degassing → cooking → vacuum packing → sterilization → cooling → finished products

Standards for Product Quality

**Criteria for Sensory Evaluation.** It composed of ten experienced staff assessment team, conducted by sensory assessors scoring evaluation. Sensory quality assessment criteria are shown in table 1.

<table>
<thead>
<tr>
<th>The evaluation index</th>
<th>Grading</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour and luster</td>
<td>Outside surface is yellow and uniform color</td>
<td>15~20</td>
</tr>
<tr>
<td></td>
<td>Outside surface is yellow, inside some color is not uniform</td>
<td>10~14</td>
</tr>
<tr>
<td></td>
<td>Surface color is not even, white and yellow</td>
<td>5~9</td>
</tr>
<tr>
<td></td>
<td>Elasticity is moderate, the surface no cracks. Better hardness, cutting smooth level off, without bubbles or smaller bubbles and uniform distribution</td>
<td>41~50</td>
</tr>
<tr>
<td>State of organization</td>
<td>Elasticity is moderate, the surface no cracks. Has the high hardness, cutting surface smooth, there are air bubbles</td>
<td>31~40</td>
</tr>
<tr>
<td></td>
<td>Elasticity is poorer, the surface has crack. Low hardness, rougher cut, bubbles.</td>
<td>21~30</td>
</tr>
<tr>
<td>Taste</td>
<td>Taste mellow, spices (total integration, have full-bodied egg fragrance, no peculiar smell</td>
<td>21~30</td>
</tr>
<tr>
<td></td>
<td>Egg flavor slightly, spices, but no peculiar smell</td>
<td>11~20</td>
</tr>
<tr>
<td></td>
<td>No egg flavor, spices (no integration, have peculiar smell</td>
<td>1~10</td>
</tr>
</tbody>
</table>

**Experimental Design**

**Single-factor Design.**

<table>
<thead>
<tr>
<th>Level</th>
<th>Content of the carrageenan(%)</th>
<th>Content of the water(%)</th>
<th>Cooking time (min)</th>
<th>Cooking temperature (℃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2</td>
<td>10</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>15</td>
<td>15</td>
<td>110</td>
</tr>
<tr>
<td>3</td>
<td>0.4</td>
<td>20</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>0.5</td>
<td>25</td>
<td>25</td>
<td>130</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>30</td>
<td>30</td>
<td>140</td>
</tr>
</tbody>
</table>
Results and Analysis

The Results of Single Factor Test

Add carrageenan can improve the texture quality of egg dry which for different level colour and lustre, and texture, so that the hardness has a best effect [9]. As shown in Fig. 1 (a), with the increase of proportion of carrageenan to join, significant increase in hardness and gumminess ($P < 0.05$). As shown in Fig. 1 (b), the addition of carrageenan proportion of internal cohesion has no significant influence, viscous, after the first increases the trend of decrease, when the addition of carrageenan 0.4% maximum 0.975 mJ. The addition of carrageenan proportion of chewiness and the influence of the elastic as shown in Fig. 1 (c), both chewiness and elastic present the trend of chewiness first increases then decreases, the maximum value at 0.4%. When elastic add increased from 0.4% to 0.4%, greatly reduce the elastic ($P < 0.05$), and then increases to 0.6%, the elastic small increase.
In eggs dry production process, the content of water and the settings of the parameters will impact on the color, quality of the eggs dry [10-11]. As shown in Fig. 2 (a) and (c), when adding water increased from 10% to 20%, hardness, gumminess, chewiness and elastic are constantly increasing. When the water rate increases to 25%, the four properties index and fell to the lowest. Considering the change trend of each index, the optimum water ratio is 20%.

As shown in Fig. 3 (a), (b), (c), the elastic, cohesion, gumminess and chewiness increase significantly when 10min to 15min (P < 0.05), and obtain the maximum value at the time of 15 min. The figure 3.3(b) shows that with the increase of cooking time, viscous decrease then increase first, you have the maximum in 15min is 0.89 mJ. The Fig. 3 (a) shows that along with the rising of the cooking time, hardness increases first, obtain the maximum value in 20min, then decreased. But considering the physical properties of cooking time, the optimal parameter is 15min.
As shown in Fig. 4 (a), (b), (c), when cooking temperature is 120 °C, various physical property indexes of eggs dry reached a maximum, as temperatures continue to rise, hardness, gumminess, chewiness to chew a significant reduction in the present, so when the temperature is 120 °C, eggs dry did good physical properties.

**Results of the Orthogonal Experiment**

<table>
<thead>
<tr>
<th>Experiment number</th>
<th>Factors</th>
<th>Sensory score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>3</td>
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<tr>
<td>K1</td>
<td>236</td>
<td>243</td>
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<tr>
<td>K2</td>
<td>267</td>
<td>259</td>
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<td>K3</td>
<td>249</td>
<td>250</td>
</tr>
<tr>
<td>k1</td>
<td>78.7</td>
<td>81</td>
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<tr>
<td>k2</td>
<td>89</td>
<td>86.3</td>
</tr>
<tr>
<td>k3</td>
<td>83</td>
<td>83.3</td>
</tr>
<tr>
<td>R</td>
<td>10.3</td>
<td>5.3</td>
</tr>
</tbody>
</table>

By table 3, it can be seen that primary and secondary order of factors affecting eggs do comprehensive quality of A > C > B > D. The optimal processing parameters are selected for A_2B_3C_2D_2. But as a result of the orthogonal experiment design in the table have no this plan, so the
scheme $A_2B_2C_2D_2$ and table experiment with the fifth $A_2B_2C_3D_1$ do contrast. Through the verification test, the formula of eggs dry do indeed better than the fifth experimental results. Therefore, $A_2B_2C_2D_2$ as the best formula.

**Conclusion**
This experiment adopts the single factor and orthogonal experiment. The best formula is: carrageenan 0.4%, water 20%, cooking time 15 min, cooking temperature 120 ℃. according to the formula in the production, the egg dry has neat shape, the colour and lustre is uniform, the nutrition is rich and it has eggs flavor. Therefore, it has a broad prospect of development and utilization.

**References**


