

High Pressure Application on Processing Mayonnaise

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Abstract: Mayonnaise is a sort of emulsifying semisolid, high nutrition value and distinctive flavour condiment. Mayonnaise has been sold on the market of our country, but price is rather high, therefore it is imperative that the suitable product for Chinese should be improved in price and taste. In this paper, to reduce production cost and prolong the shelf life are two major problems. Combined design of mayonnaise formulation decision-making variables, restraint conditions and mathematics model of cost would be established. The optimal formula of minimum cost is gotten with the function of Excel programming calculation. It may provide valuable reference for the application of computer in prescription design. The optimum advantages of high pressure processing are not only to sterilize at room temperature, but also to get the mayonnaise with new properties. Since mayonnaise cannot be heated up to sterilize. It is suggested that mayonnaise should be processed at 300 MPa for 5 mins, so the commercial germless requirement would be met. From the near-infrared spectrum (NIRS) assay of mayonnaise and its components, it was discovered that the NIRS change of mayonnaise is very similar with the NIRS assay of yolk. It showed that the NIRS change of mayonnaise processed by high pressure is caused mostly by yolk, but we cannot expel the interaction of components.

Key words: mayonnaise; high pressure; optimization

高压在蛋黄酱加工过程中的应用

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摘 要: 蛋黄酱是一种乳化性半固体食品, 营养丰富、口味醇香。目前, 我国市场上已有蛋黄酱出售, 但价格比较高, 因此研制适合中国人口味, 并且价格适宜的产品, 抢占被进口产品垄断的市场势在必行。降低生产成本和延长货架期是本实验要研究的两个主要问题。结合蛋黄酱配方设计要求确定决策变量和约束条件, 建立了成本的数学模型, 本实验借助 Excel 规划求解功能, 确定了蛋黄酱成本最低时的优化配方, 为计算机在配方设计中的应用提供了一定的参考; 高压加工方法的最大优点是它能在常温或较低温度下达到灭菌效果, 还可以获得具有新特性的食品。由于蛋黄酱不能进行加热杀菌, 所以在本研究中提出采用高压技术对蛋黄酱进行处理, 加工条件选用 300MPa、5min, 在该条件下高压加工的蛋黄酱满足了食品卫生标准, 保证了营养价值基本不变; 使用近红外分

收稿日期: 2007-07-18

基金项目: 教育部科学技术研究重点项目(207060)

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析技术对蛋黄酱的组成成分变化进行了初步的定性分析,说明蛋黄酱由高压加工引起的变化主要是由其组成成分之一的蛋黄引起的,但也不排除各组分之间的相互作用。

关键词: 蛋黄酱; 高压; 优化

中图分类号: TS202

文献标识码: A

文章编号: 1002-6630(2007)10-0297-05

1 Introduction

Mayonnaise is a sort of emulsifying semisolid, high nutrition value and distinctive flavor condiment. It is made of yolk, edible vegetable oil and other condiments. Now, it has become a necessity on many national daily dining tables. Mayonnaise has been sold on the market of our country, but price is rather high, because of the major reason that these products are imported or produced by Chinese-foreign joint corporation. Along with the change of food acceptance of the people, the demand for mayonnaise increases. Therefore it is imperative that we should develop suitable mayonnaise product for Chinese favorable both in price and taste with potential market outlook.

In mayonnaise, it is the lecithin that takes major role of emulsification. However lecithin is easy to decompose when sterilized with heating. Its strength is efficient at 25 °C, and lost basically beyond 50 °C, because heating can destroy mayonnaise's structure and nutrition composition^[1-2]. The biggest advantage of high pressure processing is that it can sterilize at normal or lower temperature and gain new characteristic food, therefore mayonnaise is processed by high pressure technique in this paper, so as to reduce production cost and prolong the shelf life.

2 Optimal Formulation of Mayonnaise

The major raw material of mayonnaise is vegetable oil, yolk, edible vinegar and salt; other raw material is granulated sugar, monosodium glutamate, mustard and white pepper and so on. The referenced market price list of raw materials is shown in Table 1.

From Table 1, the mathematics model of cost can be gotten as follows

$$\text{Cost} = f(x) = 11.1x_1 + 6x_2 + 3.6x_3 + 1.6x_4 + 29x_5 + 5.6x_6 + 30x_7$$

Where x_1 , x_2 , x_3 , x_4 , x_5 , x_6 and x_7 are called as the decision-making variables.

Ensured mayonnaise's quality as a premise, the restraint

conditions should be satisfied according to production practice as well as other relevant information^[3-4].

$$10 \leq x_1 \leq 20$$

$$60 \leq x_2 \leq 74$$

$$8 \leq x_3 \leq 17$$

$$1 \leq x_4 \leq 2$$

$$0.5 \leq x_5 \leq 1.5$$

$$1.5 \leq x_6 \leq 3$$

$$0.1 \leq x_7 \leq 0.5$$

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 = 100$$

The optimal formulation at minimum cost is gotten with the function of Excel programming calculation. It may provide valuable reference for the application of computer in formulation design. The results are: the price per 100 kg is 614.1 Yuan, and the optimization of formulation—yolk 10%, salad oil 67.4%, vinegar 17%, salt 2%, mustard powder 0.5%, granulated sugar 3%, and white pepper powder 0.1%.

3 Flow Technology and High Pressure Processing

Production flow technology of mayonnaise: The production technology of mayonnaise can adopt alternant method, intermittent method or continuous method. It takes two phases—to mix and to emulsify, and the forms the new type emulsion of oil wrapped by water. The method adopted is the alternant method, and the production technology is as follows:

Weigh raw materials→add flavor materials into yolk→stir evenly→add part salad oil to stir→add vinegar and salad oil alternately to stir→bagging and airproofing→high pressure processing→sample

High Pressure Processing: In the experiments, the maximum working pressure of high-pressure equipment is 700MPa. The equipment consists mostly of a high-pressure vessel in closure, a pressure-generation system, and accessories. High pressure is generated by indirect compression. Supercharger produces high pressure through pumping the pressure medium from the reservoir into the

Table 1 Price list of raw materials

Component	Yolk x_1	salad oil x_2	Vinegar x_3	Salt x_4	mustard powder x_5	granulated sugar x_6	white pepper x_7
Price(Yuan/kg)	11.1	6	3.6	1.6	29	5.6	30

closed vessel for thus samples to be processed. The process has four steps: (1) Samples sealed in vacuum-packed bags are placed into the high pressure vessel, then the vessel is closed and sealed; (2) Start high pressure pump, so high pressure is generated and maintained at the desired pressure for certain time; (3) After the high pressure treatment, the high pressure control oil valve is opened to released the pressure; (4) To experiment sample is gained and packed.

Experimental pressure is from 100MPa to 600MPa, with processing time (holding time) 5mins each. Control sample is unpressurized sample. All experiments are carried out at room temperature.

4 Selection of Packing Materials

Selection principle: During the processing of high pressure, the selection of packing materials should satisfy three basic conditions: (1) The pressure can be transmitted; (2) They cannot be destroyed under high pressure; (3) They will prevent the medium permeation of high pressure. Most plastic film can satisfy the former two requirements for packing in the high pressure processing. In order to avoid medium permeation prevention, the plastic film should have greater thickness. However it cannot be too thick for economic and practical consideration. The packing materials need to have certain gas permeability. If the air is being isolated completely, the no-oxygen state can be formed in the packing bag, which can result in increase and reproduction of the anaerobes. Therefore the permeability of packing material should be tested. PA/PE (nylon/ polyethylene), PET/PE (polyester/ polyethylene) or PP/PE (polypropylene/ polyethylene) compound membrane is chosen in this paper for gas permeability.

The testing instrument of gas permeability: The testing instrument of gas permeability includes GDP-C gas permeability instrument, B401L water tank of low and constant temperature, YQY-1 oxygen pressure regulator, ZXZ-1 rotary vane series vacuum pump, computer (with GDP-C systematic data and operating software) and oxygen bottle etc.

Testing data and analysis: Gas permeability quantity is expressed as the gas volume of unit area permeating from the sample under constant temperature and unit pressure difference when the gas is steadily permeable. The thickness of PA/PE, PET/PE or PP/PE is chosen for 0.065 mm, and thickness of polyethylene 0.05 mm. The testing curves are shown in Fig. 1, and the data shown in Table 2.

Discussion: The mayonnaise samples packed by the above 3 kinds of material do not show the medium permeabil-

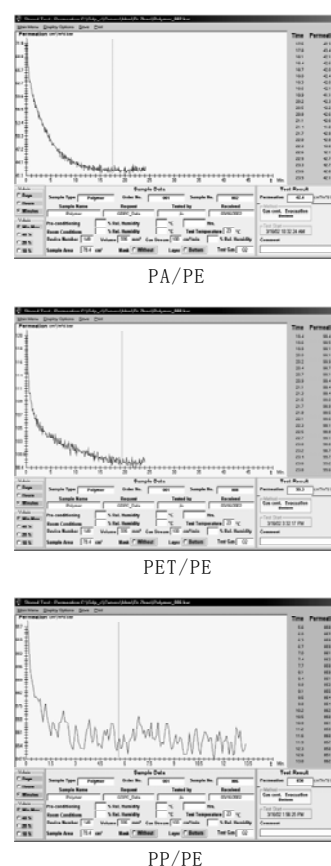


Fig.1 Testing curves of gas permeability of packing materials

Table 2 Data of gas permeability of packing materials

Material	PA/PE	PET/PE	PP/PE
Permeability (cm ³ /m ² d bar)	42.4	99.3	858

ity phenomena after high pressure processing. The products through high pressure processing are stored for 3 months, the change conditions in storage course observed. The color change of product is found greater because PP/PE permeability is too high. The smell change is greater between fresh mayonnaise and the product stored after 3 months because gas permeability hindrance of PA/PE is too strong, so PET/PE is suitable. Therefore PP/PE compound membrane is selected as the packing material of experimental sample.

5 Analysis of Near-infrared Spectrum

For the mayonnaise sterilization with high pressure, any change in its nutrition composition and nutrition value would be an important problem to mayonnaise with high pressure processing. But its components are rather complex, so it is very difficult to analyze and appraise particularly the effects of high pressure vs. every component of mayonnaise; Yet the method of chemical analysis is even more difficult. However

the above problems can be solved if the advanced and simple method-near-infrared spectrum analysis is used as such a kind of method.

Testing equipment: The WQF-400N fourier transform near-infrared spectrometer is used in this experiment. This instrument can be divided into the following function parts: infrared light source, interferometer, sample room, infrared detector, circuit system and data processing system. In addition, the instrument adopts FTIR spectrum collection system, spectrum processing system, and the near-infrared spectral quantitative analysis software of CAUNIRFT 4.0.

Experimental results: The near-infrared spectra (NIRS) of mayonnaise and its components before and after high pressure processing are shown in Fig. 2 to Fig. 5.

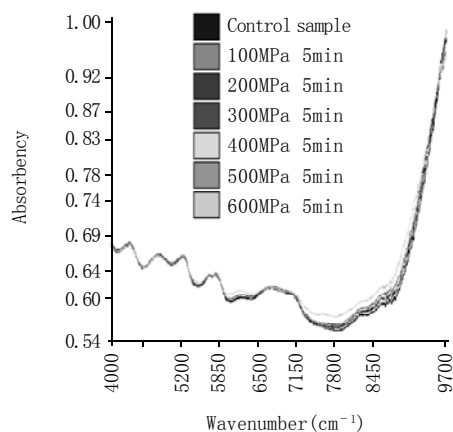


Fig.2 Near infrared spectra of mayonnaise

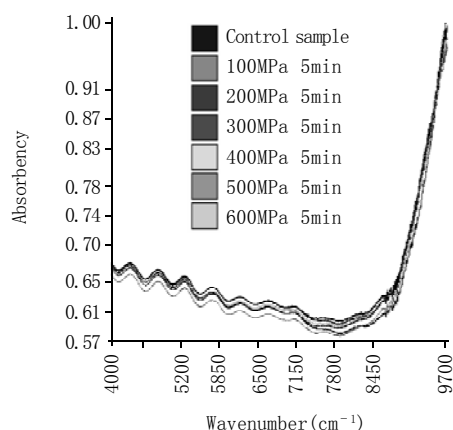


Fig.3 Near infrared spectra of yolk

Note: x-coordinate shows wave number, and y-coordinate shows absorbency value in Fig. 2 to Fig. 5.

The testing data show that the near infrared spectra of mayonnaise (Fig. 2) and yolk (Fig. 3) are very similar. The effects of high pressure for salad oil (Fig. 5) and vinegar (Fig. 4)

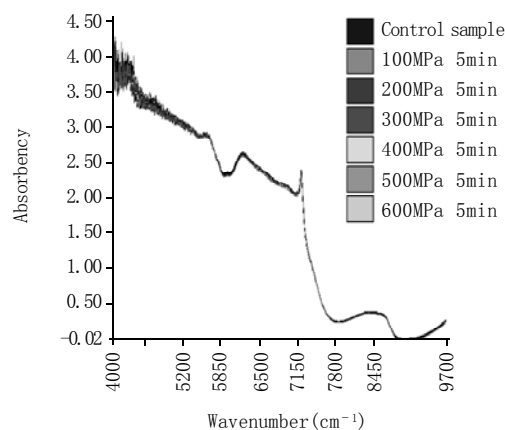


Fig.4 Near infrared spectra of vinegar

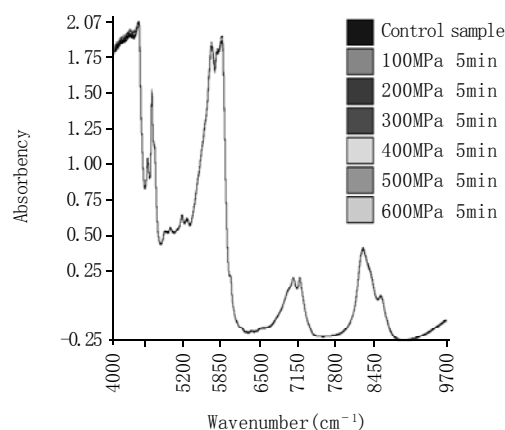


Fig.5 Near infrared spectra of salad oil

are of very little difference. It shows that the near-infrared spectra changes of mayonnaise processed by high pressure are mostly caused by yolk, that is the denaturalization of protein, but cannot expel the interactions of components.

6 Effects of High Pressure for Microorganisms

The authoritative Food Industrial Product Quality Supervising and Testing Station of Jilin Province inspected the total of germ and *E. coli* in mayonnaise after high pressure processing of 300 MPa for 5 mins. The assay adopted plate count method, while inspection standard was adopted according to GB 4789.2—94 and GB 4789.3—94. The results showed that the germ total of control sample is $1.4 \times 10^3/\text{g}$ and *E. coli* total is smaller than 30/100g. After high pressure processing of 300 MPa for 5 min, the germ total is 40/g and *E. coli* total is smaller than 30/100g. Thus the sterilization effects of high pressure processing are positive, and the mayonnaise product is in accordance with hygiene standard for food. Besides, the high pressure processing is usually applied as the final working procedure of processing, to reduce the

物理场强化葛根总黄酮提取的研究

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摘要: 本实验以乙醇为溶剂, 研究了超声功率、超声作用时间以及微波作用功率、作用时间对葛根总黄酮提取率的影响, 结果表明, 适当的超声场和微波辐射可提高葛根总黄酮的提取率。

关键词: 葛根; 总黄酮; 超声提取; 微波提取

Study on Extaction of Total Flavones from *Pueraria lobata* Ohwi by Ultrasonic and Microwave

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Abstract: The total flavones were extracted by alcohol as the solvent from *Pueraria lobata* Ohwi by ultrasonic and microwave. The effect of the power of ultrasonic field, the period of ultrasonic treatment and the power of microwave, the period of microwave treatment was studied. Under the suitable condition with ultrasonic and microwave, the extraction yield of the total flavones could be increased.

Key words *Pueraria lobata* Ohwi; total flavones; ultrasonic extraction; microwave extraction

中图分类号: TQ461

文献标识码: A

文章编号: 1002-6630(2007)10-0301-03

黄酮类化合物具有许多有益的生理效应与药理作用, 越来越引起人们的重视, 其广泛存在于植物的叶

子和果实中。既是中药材、又营养丰富的葛根中含有多种异黄酮, 具有抗氧化、抑菌、抗癌作用, 能够

收稿日期: 2007-07-15

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pollutive opportunity to the least and prolong the shelf life of merchandise.

7 Conclusion

Combined design requirement of mayonnaise formulation the decision-making variables, restraint conditions and mathematics model of cost are established. The optimal formulation of minimum cost is gotten with the function of Excel programming calculation. It may provide valuable reference for the application of computer in formulation design.

The biggest advantages of high pressure processing are not only to sterilize at room temperature, but also give the food new properties. Mayonnaise cannot be heated up to sterilization, so in this paper, it is suggested that high pressure processing would be treated for mayonnaise under 300 MPa and 5 mins, and the

commercial germless requirement will be met.

From the near-infrared spectrum (NIRS) assay of mayonnaise and its components, it was discovered that the change of the NIRS of mayonnaise is very similar to that of the NIRS of yolk, and it showed that the NIRS change of HPP mayonnaise is caused mostly by yolk, but cannot expel the interactions of components.

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