Research Article
Study on Processing Technology and a Complex Stabilizer for Peanut Protein Beverage

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Abstract: The development of the processing technology and a complex stabilizer for the peanut protein beverage processed was presented in this study. The suitable peeling conditions for peanut were: to made it soak with soft water containing 5% $NaHCO_3$ for 12 h. The best homogenizing temperature, pressure and times were 75°C, 30MPa and twice. The sterilization condition of 121°C and 15 min was the foundation to achieve the best stability. The composition of the stabilizer was optimized by uniform design combined with regression analysis based on sensory evaluation, which was achieved using fuzzy comprehensive evaluation method. The 100 mL of peanut protein beverage added with 0.4 g of sodium carboxymethyl cellulose (CMC-Na), 0.2 g of sodium alginate and 0.6 g of gelatin displayed good stability. CMC-Na amount had the largest effect on beverage stability and the effect of gelatin amount was the smallest. The peanut protein beverage with added optimized complex stabilizer was medium preference grade.

Keywords: Peanut protein beverage, processing technology, stabilizer

INTRODUCTION

The food industry develops more and more protein beverage based on emulsions. Physical stability of a protein beverage is on one of the primary determinants of the shelf life. Nowadays, protein beverage (Bhatia and Chawla, 2004) compounded variations depending on the application required: different flavours from the old chocolate milk to the new fashionable mixtures of milk and juice; different additives giving milk enriched in vitamins, calcium, minerals for healthy drinks, etc. However, addition of these different raw materials into an already metastable colloidal product, it leads to important instabilities needed to be solved by the formulator (Conti *et al.*, 2012). Sedimentation and phase separation are the common stability methods. Most of the research in literature is about stability of drinkable yogurts; however, not all protein beverages are produced from fermented milk. With the use of acids or fermentation it is possible to make products that have different levels of protein, fat or protein fractions (Abughoush *et al.*, 2008).

Peanut is well-nourished, including rich protein, a considerable proportion of the amino acid composition, all of the eight essential amino acids, glutamate and aspartate which can promote the growth of brain cells and enhance memory (Kane *et al.*, 2010). Peanut protein beverage is abundant in protein, various amino acids, vitamins, unsaturated fatty acids and cholesterol-free which are easily absorbed, with good nutrition and health effects (Deshpande *et al.*, 2005). It is very popular especially in China, South East Asia and the Netherlands. The main goal of this study was to develop the processing technology and a complex stabilizer of peanut protein beverage.

MATERIALS AND METHODS

Equipments: Far-infrared oven (Huaxing Industrial Co., Ltd. Foshan City, Guangdong), DM-WP Series milling machine (United Food Machinery Co., Ltd, Guangdong), JMS-50 split speed colloid mill (Gallery General Machinery Co., Ltd.), GYB60-6S high-pressure homogenizer (Shanghai Donghua High pressure homogenization machine Co., Ltd.), 101 series heating and drying oven (Beijing Guangming Medical Instrument Co., Ltd.), GMSX-280 portable pressure steam sterilizer (Beijing Guangming Medical Instrument Co., Ltd.), KNZ-280 digital gas bath temperature oscillators (Sinovac Co., Ltd.).

Materials: Peanut and sugar were bought from Wuhan Optical Valley Carrefour Supermarket) carboxymethyl cellulose, sodium carboxymethyl cellulose, sodium alginate and gelatin were bought from Gelatin Co., Ltd. All reagents are chemically purity grade.

Main process: Select peanut→bake→take off red clothes→soak with soft water→rinse→defibrine→filter→mashoff→colloid mill refine→ingredients→high pressure homogenize→furnish→homogenize→bottle→fill→sterilize→cool and store.

Homogeneous: First homogeneous at 70-80°C after boiling step, the pressure was 25-30 Mpa. After the furnishing, the slurry's temperature was kept at 70-80°C, the pressure 15.18 Mpa, then homogeneous again. As consequence, the feed liquid had a sufficient emulsification to achieve the goal of long-term stability.

Filling: Hot filling under 70-80°C, sealing immediately.

Sterilization and cooling: The condition of sterilization was 121°C for 15 min. The emulsion had been cooled to room temperature rapidly after sterilization to ensure the quality of the product.

The screening of stabilizer and the optimization of compound stabilizer:
The selection of a single stabilizer: Several common stabilizers (CMC-Na, sodium alginate and gelatin) had been chosen in this study. The single factor experiment was made initial selection of various stabilizers of their impact on the stability of beverage. The temperature was also considered in the experiment.

The optimization of a complex stabilizer: Evaluation the stability of peanut milk tea from the flow, precipitation, fat floating which was the stability index collection of peanut milk tea beverage and to formulate reference standards.

The determination of comment collection: Ten undergraduate students from the major of food science and technology, Wuhan Institute of Technology, specialty evaluated the peanut beverage, including the taste, aroma, body, color of samples. The scoring system used the previous method (Zhao *et al.*, 2012) and made a small modification.

RESULTS AND DISCUSSION

Determination of the processing technology: According to the range analysis of experiments, the suitable peeling conditions for peanut were: to made it soak with soft water containing 5% NaHCO3 for 12 h. The best homogenizing temperature, pressure and times were 75°C, 30MPa and twice. The sterilization condition of 121°C and 15 min was the foundation to achieve the best stability.

Evaluation of the stability:
Single stabilizer: The product without a stabilizer was found to be not stable and formed dense sediment within a week of filling. As shown in Table 1, the stability of peanut protein beverage achieved the best results when using CMC-Na comparing with sodium alginate and gelatin at room temperature. Sediment thickness of CMC-Na, sodium alginate and gelatin was 2, 3, 5 mm, respectively, when storage temperature as 5°C for 5 days. CMC-Na was used as a thickener, binder, stabilizer, suspending and water-retaining agent in pharmaceutical, food and other major industries (Zeng *et al.*, 2013). When storage temperature as 5°C for 5 days, it was observed that there was a layer of at the bottom. Sediment thickness of CMC-Na, sodium alginate and gelatin was 4, 6 and 7 mm, respectively. From the results, it indicated that the stability of peanut protein beverage effected by the storage temperature. Low storage temperature (5°C) lead to generate condensation precipitation.

Chen *et al*. (1996) reported that heat stability and storage stability of Microcrystalline Cellulose (MCC) between 20 and 90°C, found that there was minimal decrease in the viscosity. The viscosity was also measured over one year of storage and there was minimal change on the viscosity. Lucey *et al*. (1999) reported that heat treatment of the milk or storage temperature did not influence on the stability of the beverage. CMC-Na and MCC have good heat stability and storage stability. But protein beverage has complex component, not just single substance, which influenced on the stability.

Complex stability: The results of orthogonal experiments shown in Table 2, the best formula of a complex stabilizer for peanut protein beverage was $A_2B_1C_3$, namely the CMC-Na 0.4 g/ L, sodium alginate 0.2 g/ L, gelatin 0.6 g/ L. CMC-Na amount had the largest effect on beverage stability and the effect of gelatin amount was the smallest. Despite the homogenization received during the processing the formulation without any stabilizer developed compact sediment. Homogenization is not expected to eliminate sediment. In Wearly's thesis (Wearly, 2009), it reported that the effect at various homogenization levels (2,220, 4,350, 6,500 and 8,700 psi) in a cultured milk beverage

Table 1: The effect of single stabilizer in peanut protein beverage

Stabilizer	T (°C)	Dosage (g/L)	Precipitation rate (%)	Modality
CMC-Na	20	1.0	2.77	Uniformity
	5	1.0	4.13	Uniformity
Sodium alginate	20	1.0	4.44	Uniformity
	5	1.0	4.97	Less uniformity
Gelatin	20	1.0	3.42	Uniformity
	5	1.0	5.32	Less uniformity

Table 2: L9 (33) orthogonal array

EXPNO	Factor			Precipitation Rate (%)
	A	B	C	
1	1(0.2)	1(0.2)	1(0.2)	2.63
2	1	2(0.4)	2(0.4)	3.61
3	1	3(0.6)	3(0.6)	2.77
4	2(0.4)	1	3	3.44
5	2	2	1	3.65
6	2	3	2	4.0
7	3(0.6)	1	2	3.50
8	3	2	3	4.06
9	3	3	1	3.91
R	0.820	0.583	0.346	
Optimal	A2	B1	C3	

Table 3: The sensory characteristics of peanut beverage

Items	Characteristic
Color	Light brown
Flavour	Fragrance good, sweetness appropriate, no peculiar smell
Taste	Taste delicate, good fluidity
Texture	Uniform fine, mix well after shaking

and found that increasing homogenization pressure resulted in reduction of the degree of sedimentation but did not prevent sedimentation. The formulation with the avicel also formed sediment, but it was loose and could be easily incorporated back into solution by shaking.

The physical indicators of the quality of test results: Sensory characteristics shown in the Table 3, the beverage presented a form of the peanut paste and blended tea brown, relatively rich aroma, the taste, suitable, no precipitation.

CONCLUSION

The results of processing technology showed that peanut needed to soak with soft water containing 5% $NaHCO_3$ for 12 hours. The best homogenizing temperature, pressure and times were 75°C, 30MPa and twice. The sterilization condition of 121°C and 15 min was the foundation to achieve the best stability. The complex stabilizers by orthogonal experiments were revealed that the 100 mL of peanut protein beverage added with 0.4 g of sodium carboxymethyl cellulose (CMC-Na), 0.2 g of sodium alginate and 0.6 g of gelatin displayed good stability. CMC-Na amount had the largest effect on beverage stability and the effect of gelatin amount was the smallest. The achieved product had soft taste, milky white and good stability.

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