Application of Octenyl Succinate Starch Ester (SSOS) in Peanut Beverage

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Abstract: In this paper, the effects of octenyl succinate starch ester, carrageenan, monoglyceride and sucrose fatty acid ester compound emulsifier on the sensory evaluation of floating layer thickness, sedimentation rate and precipitation were analyzed. the optimal scheme for making peanut protein beverage with octenyl succinate starch ester was 0.09% xanthan gum ,0.06% carrageenan ,0.15% sucrose fatty acid ester and 0.15% monoglyceride. It is proved that the application of octenyl amber acid starch ester as stabilizer in peanut protein beverage is feasible.

1 Introduction

With the improvement of people's living standard, the demand for drinks changes from the past refreshing, sweet to nutrition, health care, safety. Protein drinks have the characteristics of "green, nutrition, health" and so on. There are more and more varieties of protein drinks in the market, which occupy a more and more important market position in the beverage market. Among them, vegetable protein drinks without cholesterol are rich in nutrition and have reasonable nutrient composition.[1]Therefore, it is of great practical significance to select vegetable protein beverage as starch ester of octenyl succinate as stabilizer.

Botanical proteins are widely found in nuts, peanuts, beans and other plants, among which peanut protein and animal protein nutrition difference is small, contains 25%~36% of the protein, about 10% of the protein is water-soluble protein, called whey protein, the remaining 90% is salt-soluble protein, contains eight essential

amino acids in the human body.[2]Brain phospholipids and lecithin are important substances in nerve activity and also contain vitamin B1Vitamin E and potassium, calcium, phosphorus and other 26 minerals and trace elements[3]. Peanut can promote the metabolism of the body, prolong the life of cells, prevent the body aging, promote the development of brain cells, conducive to the growth and development of young children, increase memory and other effects. Henan Province, especially Kaifeng area, is an important base for peanut planting and comprehensive processing[4]. The production chain of peanut products is relatively complete, and the comprehensive utilization of peanut and the extension of industrial chain play an important role in increasing regional economic growth, so it is important to study peanut protein beverage as research carrier.

2 Materials and methods

2.1 Materials and reagents

Table 1. Example of materials and reagents

Name of drug	Manufacturers
Peanuts	Free Market Purchase
Amyl ester of octenyl succinate	Pilot experiment
Single Gump (food grade)	Zhengzhou Tianying Food Ingredients Company
Sucrose fatty acid esters (food grade)	Zhengzhou Tianying Food Ingredients Company
Carrageenan (food grade)	Zhengzhou Tianying Food Ingredients Company
6- Sodium metaphosphate	Tianjin Chemical Reagent 1

2.2 Instruments and equipment

Table 2. Example of Instrument and equipment

Name of name	Manufacturers
JM-50 colloid mill	Shandong Longxing Chemical Machinery Factory
SHP-1 high pressure homogenizer	SHANGHAI HANGHUA HANGHAI HANGHAI EQUALITY MACHINE
DSX-280A pressure steam sterilizer	SHANGHAI SHEN AN STEEL CO. LTD.
Electronic balance (d= 1mg)	Mettler Toledo Instruments Limited
NDJ-5S rotary viscometer	Shanghai Equity Instrument

2.3 Methodology

2.3.1 Preparation of Peanut Milk

Peanut milk preparation process: peanut seed selection → enzyme → red → softening → grinding → separation → grinding → blending → cooking → homogeneous filling, sterilization → cooling → packaging finished products

First of all, the choice of full particles, no damage, no mildew of peanut raw materials, after picking out impurities. To bake 10 min, at 130°C to passivate lipoxygenase from peanut kernel to prevent bean odor^[5]. Then, artificial removal of peanut clothing, to prevent peanut skin pigment and tannin and other substances in the soaking process attached to peanut kernel, so that the beverage color deepened, taste astringent. Add 8 times the weight of peanut kernel and 0.5% NaHCO₃ Soak and soften in dilute solution for dissolution of pulp and peanut nutrients^[6]. The soaking time depends on the water temperature, about 6~10 h, during the soaking process can simultaneously leach part of oligosaccharides to prevent abdominal distension. Soak peanut kernel with water rinse 3 to 4 times, drain, add peanut kernel 8~15 times hot water (80°C) for pulping, with 80~100 mesh sieve to separate peanut pulp residue, pulp residue can be added appropriate amount of water to grind^[7] to increase the extraction rate of nutrients. The pH value of control peanut pulp is between 6.8~7.1. Grout should be heated to more than 90°C of maturation, peanut emulsion surface foaming, false boiling, produce a lot of foam, in order to ensure quality, need to skim part of the foam. Meanwhile, according to the formulation requirements, and then at about 70°C high pressure homogenization, homogenization pressure should be in 30 MP. Filling temperature kept above 70°C, sealed to form a certain degree of vacuum, sterilization conditions more than 120°C/10 minutes of cooling, the production of peanut milk left for test reserve^[8].

Determination of 1.3.2 Peanut Protein Beverage

Precipitation Method^[9-10]

Take peanut milk 100g, add a certain concentration of stabilizer, homogenize after sterilization, can, static 48 h filtration, air-dried precipitation, determine its peanut protein beverage floating layer thickness and precipitation rate. Precipitation rate calculated by the following formula^[11]:

Precipitation rate (%)= sediment (dry weight)/ peanut powder (dry weight)×100

2.3.1.1 Effects of Monoglyceride on Peanut Milk Protein Beverage

5 pieces of peanut milk ,100 g. each adding monoglycerides with concentrations of 0,0.05,0.10,0.20 and 0.30%, respectively, after homogenization, sterilization, canning, static 48 h filtration, air-dried precipitation, to determine the floating layer thickness and precipitation rate of its peanut protein beverage. To analyze the effect of monoglyceride on peanut protein beverage.

2.3.1.2 Effects of sucrose fatty acid esters on peanut milk protein beverage

Take 5 parts of 100 g peanut milk, each 100 g, add concentration is 0.03%,0.06%,0.09%,0.12%,0.15% sucrose fatty acid ester, homogenize, sterilize, can, static 48 h after filtration. Effect of sucrose fatty acid ester on peanut protein beverage by air-dried precipitation and determination of floating layer thickness and precipitation rate of peanut protein beverage^[9].

2.3.1.3 Effects of Carrageenan on Peanut Milk Protein Beverage

Take 6 parts of peanut milk, each 100 g, add the concentration of 0,0.02%,0.03%,0.04%,0.05%,0.06% of the carrageenan, homogenized after sterilization, canned, static 48 h after filtration. the air-dried precipitate was used to determine the floating layer thickness, precipitation rate and viscosity of its peanut protein

beverage. Analysis of Effect of Carrageenan on Peanut Protein Beverage^[9].

2.3.1.4 Effects of homemade starch ester of octenylsuccinate on peanut milk protein beverage

Six parts of peanut milk were taken, each 100 g, was added with starch ester of octenylsuccinic acid at concentrations of 0,0.03%,0.06%,0.09%,0.12% and 0.15%, respectively. After homogenization, the milk was sterilized, canned, and filtered after standing for 48 h. the air-dried precipitate was used to determine the floating layer thickness, precipitation rate and viscosity of its

peanut protein beverage. To analyze the effect of octenyl succinic acid starch ester on peanut protein beverage^[9].

2.3.1.5 Effects of Compound Additives on Peanut Protein Beverage

Experience^[12]Three factors and four levels orthogonal test were selected to determine the optimal stabilizer of l: 1 mono-glycerol and sucrose fatty acid ester, including A, octenylsuccinic acid starch ester and carrageenan (C)^[13], factor level orthogonal test design is shown in Table 3.

Table 3 Example of orthogonal factor horizontal design results

Level	Factors			
	(A)	(B)	(C)	
	octenyl succinic acid starch ester (%)	Carrageenan (%)	Monoglycerides (%)	Sucrose fatty acid esters (%)
1	0.07	0.04	0.09	0.09
2	0.08	0.05	0.12	0.12
3	0.09	0.06	0.15	0.15

Determination of 1.3.3 Peanut Milk Deposit after the sample was placed at constant temperature 30°C for 7 days, a rotary viscometer was used at room temperature^[14]The viscosity resistance produced by peanut milk is expressed by the reaction torque. Advanced line correction and zero adjustment, and the instrument measuring cylinder connected with the insulation device, open the insulation device to maintain constant temperature 30°C for viscosity measurement.^[9].

3 Fruit and Analysis

3.1 Effects of Monoglyceride on Peanut Milk Protein Beverage

Experimental results are shown in figure 1. the addition amount of monoglyceride is in the range of 0~0.1%. with the increase of its addition amount, the floating layer thickness and precipitation rate of peanut protein beverage gradually decrease; but when the addition amount of monoglyceride exceeds 0.10%, the floating layer thickness and precipitation rate of peanut protein beverage increase with the increase of the addition amount. hence, when preparing the composite emulsifier, the amount of monoglyceride added should be controlled in the range of 0.05~0.2%.

Fig. 1 Effects of monoglycerides on peanut milk protein beverage

3.2 Effects of sucrose fatty acid esters on peanut milk protein beverage

Experimental results are shown in figure 2. the addition of sucrose fatty acid ester is in the range of 0.03~0.15%. with the increase of its addition, the floating layer thickness and precipitation rate of peanut protein beverage gradually decrease. But the maximum use limit

of sucrose fatty acid ester is 0.15%, so the amount of sucrose fatty acid ester should be increased as much as possible within the scope of national standard operation, and the amount of monoglyceride added should be controlled within 0.12~0.15% when preparing compound emulsifier.

Fig.2 Effect of sucrose fatty ester on peanut milk protein beverage

3.3 Effects of Carrageenan on Peanut Milk Protein Beverage

The results are shown in Fig .3. With the addition of carrageenan in the range of 0.0-0.06%, the floating layer thickness of peanut protein beverage decreases gradually, but the viscosity increases gradually. Therefore, the dosage of carrageenan should be chosen at 0.04-0.06%

Fig. 3 Effect of carrageenan on peanut milk protein beverage

3.4 Effects of starch ester of octenyl succinate on peanut milk protein beverage

The results are shown in Fig .4. The floating layer thickness of arachidonic beverage decreases and tends to stabilize with the addition of octenylsuccinate in the range of 0.0-0.15%. The viscosity increases with the

addition of octenylsuccinate starch^[15]The precipitation rate decreased in the range of 0.0-0.09% and increased with the addition of starch ester of octenyl succinate when the addition amount was more than 0.09%. So the dosage of xanthan gum should be in the range of 0.06-0.09%.

Fig. 4 Effect of starch octenyl succinate on peanut milk protein beverage

3.5 Effects of Compound Additives on Peanut Protein Beverage

Through the orthogonal test, the results are shown in Table 4, and the results of the range analysis can be seen that the factors are different^[16]The influence degree on the thickness of floating layer is in order of single glycolipid, sucrose fatty acid ester compound

emulsifier > octenyl succinate starch ester > carrageenan; the influence degree on precipitation rate is in order of carrageenan > monosaccharide, sucrose fatty acid ester compound emulsifier > octenyl succinate starch ester; the influence degree of sensory evaluation is in order of single glycolipid, sucrose fatty acid ester compound emulsifier > carrageenan > octenyl succinate starch ester.

Table 4 Example of orthogonal experimental results

Number	A	B	C	Float thickness	Precipitation rate	Sensory evaluation
1	1	1	1	1.2	0.244	56
2	1	2	2	1.5	0.289	82
3	1	3	3	0.5	0.252	92
4	2	2	3	0.8	0.305	90
5	2	3	1	1.3	0.179	70
6	2	1	2	1.5	0.385	65
7	3	3	2	2.0	0.317	85
8	3	1	3	1.2	0.436	73
9	3	2	1	1.7	0.262	62
$K_{\text{Float 1}}$	3.2	3.9	4.2	$DF_A=2, MS_A=0.263333, F_A=26.33, P_A=0.0366$		
$K_{\text{Float 2}}$	3.6	4.0	5.0	$DF_B=2, MS_B=0.003333, F_B=0.33, P_B=0.7500$		
$K_{\text{Float 3}}$	4.9	3.8	2.5	$DF_C=2, MS_C=0.543333, F_C=54.33, P_C=0.0181$		
$R_{\text{Floating layer}}$	1.7	0.2	2.5	$P_A=0.0366 < 0.05, P_B=0.7500 > 0.05, P_C=0.0181 < 0.05$		
$K_{\text{Precipitation rate 1}}$	0.785	1.065	0.685	$DF_A=2, MS_A=0.008657, F_A=60.92, P_A=0.0161$		
$K_{\text{Precipitation rate 2}}$	0.8699	0.856	0.991	$DF_B=2, MS_B=0.010472, F_B=73.69, P_B=0.0134$		
$K_{\text{Precipitation rate 3}}$	1.014	0.748	0.993	$DF_C=2, MS_C=0.004515, F_C=31.77, P_C=0.0305$		
$R_{\text{Precipitation rate}}$	0.23	0.317	0.308	$P_A=0.0305 < 0.05, P_B=0.0134 < 0.05, P_C=0.0161 < 0.05$		
$K_{\text{Sensory 1}}$	230	194	188	$DF_A=2, MS_A=8.333333, F_A=0.69, P_A=0.5902$		
$K_{\text{Sensory 2}}$	250	234	232	$DF_B=2, MS_B=254.333333, F_B=21.69, P_B=0.0451$		
$K_{\text{Sensory 3}}$	220	247	255	$DF_C=2, MS_C=386.333333, F_C=32.19, P_C=0.0301$		
R_{Senses}	10	53	67	$P_A=0.5902 > 0.05, P_B=0.0451 < 0.05, P_C=0.0301 < 0.05$		

A significant test on the floating layer thickness of arachidonic protein beverage showed that the probability of octenyl succinate starch ester, monoglyceride and sucrose fatty acid ester compound emulsifiers were P , respectively $P_A=0.0366<0.05$ and $P_C=0.0181<0.05$, indicating that the effect of octenyl succinate starch ester, monoglyceride, sucrose fatty acid ester compound emulsifier on peanut protein beverage reached a significant level. P probability of carrageenan $P_C=0.0181>0.05$, indicating that there was no significant difference in the effect of 3 levels of carrageenan on peanut protein drinks. According to the above analysis, the optimal level can be 0.15% single glycolipid, 0.15% sucrose fatty acid ester, 0.09% xanthan gum and 0.04% carrageenan respectively.

A significant test was made on the sedimentation rate of peanut protein beverage. It was found that the probability of octenyl succinate starch ester, carrageenan and single glycolipid sucrose fatty acid ester compound emulsifier were $P_A=0.0161<0.05$, $P_B=0.0134<0.05$, $P_C=0.0305<0.05$, indicating that the effects of octenyl succinate starch ester, carrageenan and single glycolipid, sucrose fatty acid ester compound emulsifier on peanut protein beverage were all significant, and the optimal level could be 0.09% of octenyl succinate starch ester, 0.06% of carrageenan and 0.3% of total compound emulsifier.

A significant test on the sedimentation rate of peanut protein beverage showed that the ending probability of carrageenan and compound emulsifier were P , respectively $P_B=0.0451<0.05$ and $P_C=0.0301<0.05$, which indicated that factors carrageenan and compound emulsifier had significant effect on peanut protein beverage. Effect of octenyl succinic acid starch ester on peanut protein beverage was not P significantly $P_A=0.5902>0.05$, indicating that there was no significant difference in the effect of three concentration levels, such as 0.07%, 0.08% and 0.09%, on peanut protein beverage. Therefore, the optimal level is 0.07% of octenyl succinate starch ester, 0.06% of carrageenan and 0.3% of compound emulsifier.

4 Discussion

Through the analysis of variance and significance of orthogonal experiment, octenyl amber acid starch ester, carrageenan, single glycolipid, sucrose fatty acid ester compound emulsifier all have influence on floating layer thickness, sedimentation rate and precipitation sensory evaluation simultaneously. The effect of carrageenan on the precipitation rate and sensory effect of peanut protein beverage was significant, but not on the floating layer. therefore, the optimal scheme for making peanut protein drinks using octenyl succinate starch ester is 0.09% xanthan gum, 0.06% carrageenan, 0.15% sucrose fatty acid ester, 0.15% monoglyceride. The experiment proves that the application of octenyl succinate starch ester as stabilizer in beverage is feasible.

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