Research on Application of Texture Soybean Protein in Meat Stuffed Product

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SUMMARY

Texture Soybean Protein (TSP) processes some very good characteristics of Water-Holding Capacity (WHC), oleophilic capacity and emusification. Its soybean odor and air-inflating content can be eliminated through appropriate processing methods. When applied in Meat Stuffed Products (MSP) (such as sausage products), TSP would not only increase protein quantity in the product, but also complement animal protein and the product's physiological value is raised as a result. This research is significant in that, by improving Chinese people's daily protein ingestive quantity, both social and economic effect are achieved.

PREFACE

TSP is an ideal source of protein needed by human beings. This has long been recognized by nutrition researchers of the world. As a developing country, the average food supply in China is only 400 Kilograms per capita and it is unlikely this will change in great extent. Obviously, the state is unable to dramatically increase the protein ingestive quantity for its population merely by means of transforming grain into animal protein.

Soybean is a major cash crop in China and its output is in the top rank among soybean producing countries. It provides us excellent edible protein an a research on partial substitution of soybean protein for animal protein in both meaningful and significant.

TSP is a soybean protein product that is made from defatted soybean powder and maintains fibrous texture and masticability. It contains as much as 50% of protein content. Adding TSP into MSP has become an effective way to help cope with the problem of short supply of lean meat and oversupply of fat meat in today's meat product-making factories.

TSP itself has soybean odor and air-inflating content and this has limited its widespread application in food processing businesses. On the basis of study of the components of TSP, this paper made great effort to analyze TSP's basic characteristics and developed an optimal treatment technique to eliminate soybean oder and air-inflating content existing in TSP by orthogonal test method. The paper also focused on the application of TSP in making of MSP and introduced a guideline to the MSP production.

MATERIALS AND METHOD:

1. Materials: TSP, lean pork meat, fat pork meat, seasonings, binding agent, edible acid and soda, etc.

2. Instrument and Apparatus: centrifuge, homogenizer-mixer, small sausage making machinery, gas chromatography, etc.

3. Method:

3.1 Basic component analysis: regular analytical methods were used in obtaining protein, fat and other physic and chemical results.

3.2 Basic Characteristics: WHC, oleophilic capacity and emulsification data all used Japan Agri-Forest Specifications (JAS).

3.3 The Optimal Treating Process of TSP

3.3.1 Selection of optimal technique in removing soybean odor:

Orthogonal test method was used to determine the conditions in removing soybean odor in TSP. Its elements and scale level is shown in Table 1.

Table 1. Elements and Scale Level

Element / Scale Level	A Treating Method	B Material vs. liquid	C Temperature (℃)	D Time (Minutes)
1	I	1:x	C_1	D_1
2	II	1:y	C_2	D_2
3	III	1:z	C_3	D_3

Adopting $L_9(3)^4$ orthogonal test table to arrange experiment, evaluation was performed and marked by sense organ. Mark scale is 8——>1 as related to "No-Soybean odor——>Original Soybean Odor"

3.3.2. Use of gas chromatography in determining air-inflating content in TSP

Under normal temperature, we used HMDS and TFA to turn the oligosaccharide in TSP into TMS state. Using pyrene as internal standard on Siliconeov-17 column, we performed a linear-programming temperature increase to undertake gas chromatography analysis.

3.4. Application of TSP in making sausage products

The key point to be emphasized in applying TSP in making sausage products is to choose the most suitable binding agent. An orthogonal test method was made to compare several binding agents commonly used in the TSP, the best one was determined by the product's sensing quality. Table 2 gives the element and scale level of the test.

Table 2. Orthogonal Test (2) Element and Scale

Element / Scale	A Carrageenin (%)	B ISP (%)	C TSP (%)	D Quality Binding Agent(%)
1	0.2	1	15	0.15
2	0.1	2	10	0.1
3	0.5	3	20	0.2

RESULT AND DISCUSSIONS

1. The Basic Characteristics of TSP

1.1 Basic components

The results of TSP's basic characteristics and its analysis are given in Table 3.

Table 3. The Basic Components of TSP (%)

Component	Protein	Fat	Carbohydrate	Water	Ash
Quantity	50.09	1.24	38.07	5.69	4.1

1.2 Water-Holding Capacity (WHC)

The WHC of TSP varies under different treatment conditions, the variances are shown in figure 1.

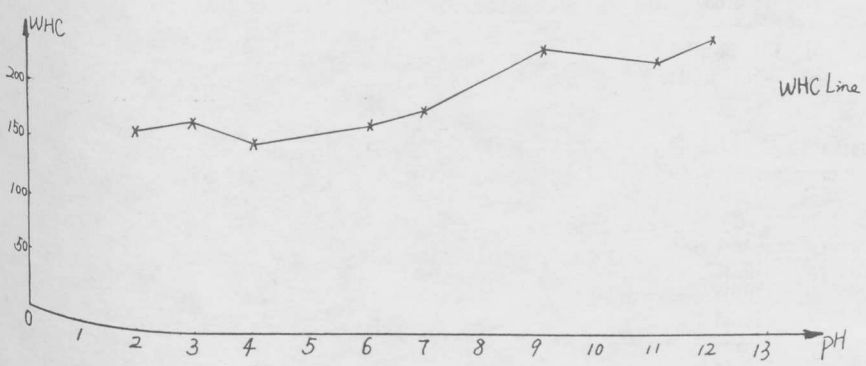

Figure 1.

The WHC of TSP varies under different treatment conditions, the variances are shown in figure 1.

As we can see from figure 1 that WHC of TSP doesn't exit when PH is less than 7, and WHC exists when greater than 7. The reason behind

this comes from the different exposure extent of the water-holding group inside protein.

1.3 Oleophilic Capacity

Observing the TSP under different treating processes through a microscope of 1:50 times and change cutting section plane by 5 times, the result is a close combination of the sample with red pork fat oil colored by Sudan III. This indicates certain oleophilic capacity of TSP.

1.4 Emulsification

The Emulsification of TSP also varies under different treatment conditions, the variances are shown in figure 2.

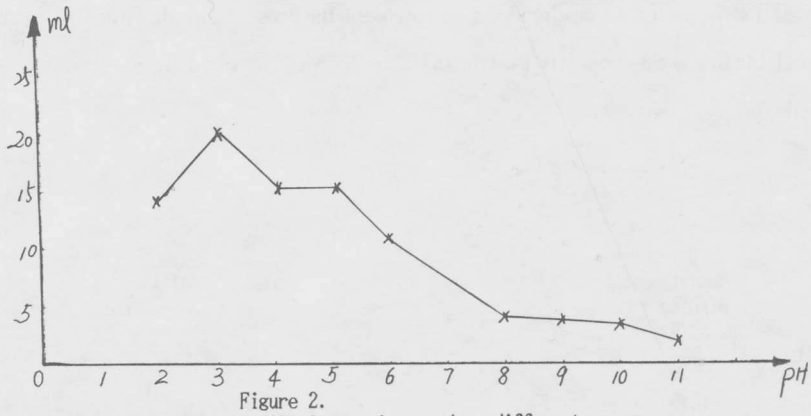

Figure 2.

The Emulsification of TSP also varies under different treatment conditions, the variances are shown in figure 2.

As shown in figure 2, the amount of water separated from TSP is less than 20 ml, this indicates its emulsification capacity and a much better emulsification capacity when PH is greater than 8.

2. Determination of the Optimal Treating Technique of TSP

Table 4 shows that after orthogonal test experiment, the processed TSP has the characteristics by sense testing.

Table 4. A comparison of Sense Judgement of TSP

Element	A	B	C	D	General
Serial Number	Processing Method	Material Vs. water	Temperature	Time	
1	1	1	1	1	6.68
2	1	2	2	2	6.63
3	1	3	3	3	6.73
4	2	1	2	3	5.83
5	2	2	3	1	5.95
6	2	3	1	2	5.73
7	3	1	3	2	6.28
8	3	2	1	3	5.88
9	3	3	2	1	6.68

Note: The "General" score is an average of 12 people's measurement results of the 3 test items (see Table 5 for analysis)

Table 5. Orthogonal Test Results

Elements / Results	A	B	C	D
K_1	20.04	18.51	18.29	19.31
K_2	17.53	18.51	19.26	19.04
K_3	18.84	19.34	18.87	18.46
k_1	6.68	6.17	6.10	6.44
k_2	5.84	6.17	6.42	6.35
k_3	6.28	6.54	6.29	6.15
Extreme Variances (R)	0.84	0.37	0.32	0.29

From Table 5. we see that the optimal technique to be used in removing soybean odor of TSP would be $A_1B_3C_2D_1$. Its significance also lessens as the order indicates: ACDB, namely Treating method, temperature, time and material and water ratio.

3. Changes of oligosaccharide in TSP

The gas chromatography measurement of TSP under different treating method is shown in Table 6.

Table 6. Changes of oligosaccharide content before and after treatment

Sample	Amount of oligosaccharide (g/100g)			Amount of oligosacchara (%) (In contrast to 100)		
	Sucrase	Cotton seed carbohydrate	Suisu Sugar (an oligosaccharide)	Sucrase	Cotton seed carnohydrate	Suisu Sugar (an oligosaccharide)
Contrast	8.38	1.42	6.67	100	100	100
PH 9	2.66	0.26	0.84	31.7	18.4	12.7
PH 7	0.56	0.20	1.50	6.7	14.1	22.5
PH 5	1.34	0.06	1.07	16.0	4.2	16.1

Table 6 shows that when the PH value of treating liquid is at 5, the residual oligosaccharide is the lowest. However, the useful sucrase is also at the lowest point. Therefore, put together we have chosen the PH value of treating liquid 9 as the optimal air-deflating condition. This selection corresponds with the optimal soybean odor-removing condition.

4. Application of TSP in MSP.

4.1 Selection of Binding Agent

An orthogonal experiment was performed using elements and scale arrangement of Table 2, the results are shown in Table 7.

Table 7. Orthogonal Test Result of Binding Agents Selection

Item	Slice Ability	Color	Scent	Form	Mouthfeel	Output Rate
Carrageenin (K)	0.5%	0.1%	0.1%	0.5%	0.2%	0.5%
Quality Binding Agent (H)	0.2%	0.15%	0.1%	0.2%	0.2%	0.2%
TSP(T)	10%	10%	15%	15%	20%	20%
ISP(I)	3%	1%	2%	3%	3%	3%
Difference Shown	K>H>I>T	No(F)	No(F)	K>H>I>T	H>I>K>T	T>K>H>I

* F means no obvious difference

As from Table 7, the optimal binding agent ratio would be carrageenin0.5%, quality binding agent 0.2%, ISP 3%, and texture protein be 15 - 20%.

4.2 The maximum additive amount of TSP

According to the results above, adding different quantity of treated TSP in making sausage gives the following results (Table 8.)

Table 8. Sensing of Sausages with Different TSP added

TSP Quantity (%)	Slice Ability	Color	Scent	Form	Mouthfeel	General
20	loose,poor	grey	odorless	soft, inflexible	sticky	unacceptible
15	fair	lighter	normal	less loose	less sticky	acceptible
10	good	normal	good	good	normal	good

this comes from the different exposure extent of the water-holding group inside protein.

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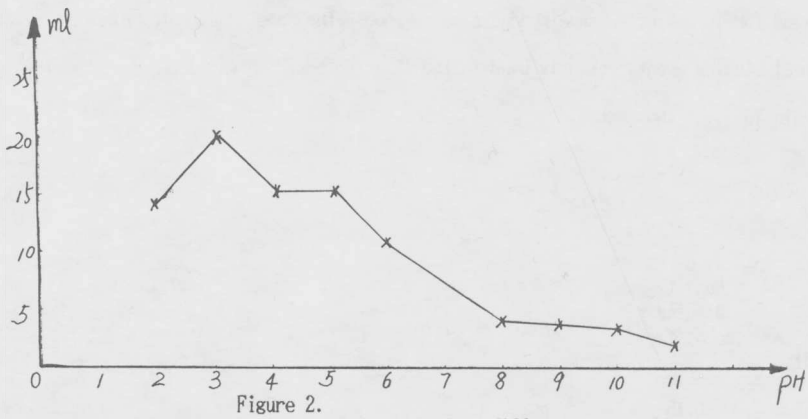

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(Continue from last page Table 8)

5	good	normal	good	good	normal	good
0	good	normal	good	good	normal	good

From Table 8 we know that TSP quantity added should be controlled at around 10 - 15%, only at which can consumer accept the product's quality.

CONCLUSION:

Through a study of basic characteristics of TSP and a discussion of soybean odor- and air-inflating materials-removing techniques, along with a research on application of the techniques in making MSP, the following conclusion can readily be made:

1. TSP is a material that has high protein content and fibrous structure. It is excellent in WHC, oleophilic capacity as well as emulsification, and is ideally a rather functional protein additive.

2. After being treated under certain conditions, odorless TSP is obtained. Those air-inflating materials such as cotton seed carbohydrate and Suisu sugar decrease by 81.6% and 87.3%, respectively after processing. This is considered to have no air-inflating effect to human body.

3. TSP may be added to sausage products after it being processed to replace lean meat. The quantity to be added would be about 10-15%, binding agent is added at the same time. The improved product not only has higher protein quantity, but also has more physiological value as its animal protein and vegetable protein complements one another. The social and economic significance is dramatic.

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