ISSN: 2414-1895 DOI: 10.6919/ICJE.202202_8(2).0041

Study on the Effect of Excipient Compound Technology on the Quality of Beef Emulsified Sausage

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Abstract

High-quality frozen beef was used in the experiment, and three kinds of auxiliary materials were studied: compound phosphate (0.1%, 0.2%, 0.3%, 0.4%, 0.5%), modified starch (1%, 1.5%, 2%, 2.5%, 3%) and salt (1%, 1.5%, 2%). The sensory evaluation is the highest when the amount of compound phosphate is 0.3%, while the added value is the highest when the amount of compound phosphate is 0.4%. Sensory evaluation is the highest when the content of modified starch is 1.5%, and added value is the highest when the content of modified starch is 2%. Through orthogonal experiment, the optimal combination was 2% salt, 0.4% compound phosphate and 1.5% modified starch.

Keywords

Emulsifying Intestine; Auxiliary Materials; Sensory Organs; Added Valu.

1. Introdution

Emulsified sausage is a cooked meat product produced by using livestock and poultry meat as the main production raw material, emulsifying the meat raw material into minced meat through the processes of pickling (or not pickling), crushing or chopping [1], adding several different seasonings, then enema, cooking and cooling. Emulsified sausage not only tastes delicate, but also has a unique flavor. It is also very convenient to carry and eat. However, in the actual production process of emulsified sausage, due to improper selection of auxiliary materials and improper control of process parameters, it is very easy to cause problems such as oil separation, poor flavor, loose structure and poor slicing of emulsified sausage. Based on the original formula of emulsified intestines, emulsified intestines were prepared by adding modified starch, compound phosphate and table salt. The water retention of the products was measured and sensory evaluation was carried out to explore the effects of different additions on their quality and water content.

Beef is rich in linoleic acid, magnesium, iron, zinc and other minerals [2], and low-fat and high protein [3]. Eating beef is very conducive to human health. Eating more beef is also the proposition of many nutrition experts. Emulsified sausage belongs to a kind of sausage, and its output accounts for a large part of sausage. Emulsified sausage not only has delicate taste, but also has unique flavor, and is very convenient to carry and eat.

In recent years, China's beef production has maintained a steady growth trend. According to the data, China is the third largest beef country, in 2018, there were 66.184 million cattle on hand, 43.975 million cattle sold, and the beef output was 6.441 million tons. In 2016, it decreased to 6.18 million tons, there has been a decline. Consumption: the world's per capita annual consumption of beef is nearly 10kg, 41kg in the United States and 12kg in South Korea; In 2018, the average beef consumption in China was 5.39kg/person [4], a year-on-year increase of 6.5%, an increase of 14.5%

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compared with that in 2008. Although China's per capita beef consumption has increased steadily for seven consecutive years, there is still a big gap with the world's per capita annual beef consumption. Using beef to make emulsified sausage is of great practical significance to increase the per capita consumption of beef in China.

Phosphate: phosphate not only increases the water holding capacity of meat products by [5], but also increases the yield of meat products, because phosphate can increase the ionic strength of meat products, and enhance the metal ions and hydration of the chelating meat system, so that the properties of gel water retention, phosphate and dissociated myosin are related to [6]. Sodium pyrophosphate has the strongest water retention in meat, potassium pyrophosphate has the general water retention in meat, and sodium tripolyphosphate has the strongest water retention in meat. The results showed that when the content of phosphate in meat was 0.4%, the increase rate was the highest, and the increase trend was slow; The yield was the highest when the dosage was 0.5%. When the content of phosphate in meat is 0.4% [7], the water content of emulsified sausage is the lowest. When the content of phosphate is between 0.2% and 0.5%, the water content of emulsified sausage does not change much. Increasing the water content of phosphate in emulsified sausage will not significantly reduce the storage loss of emulsified sausage during storage.

Table salt: table salt can effectively enhance the water retention of meat within a certain concentration range [8]. The test shows that [9]: when the salt content in meat products is 4.6 ~ 5.8%, the water retention is the strongest. Generally, the salt content in meat products is about 3%, and the water retention will decrease with the decrease of salt content. In order to maintain good water retention of meat products, water retention agents, such as polyphosphate, must be added.

Modified starch: muscle protein can form heat induced gel, and the properties of gel determine the quality of mixed meat products and meat products. Various factors in processing affect the gel properties of muscle protein, especially heating temperature and heating time. Adding deformable starch can effectively improve the water retention of heat induced gel, and modified starch can also effectively improve the hardness and elasticity of [10].

Because salt, modified starch and compound phosphate have important effects on the water retention of emulsified intestines, how to increase the water content of emulsified intestines without affecting the taste of emulsified intestines has become the research focus in this field. Based on this, this study obtains the best auxiliary material addition process by adding three kinds of auxiliary materials in different combinations, so as to obtain the water increasing treatment process that can ensure the quality of emulsified intestines.

2. Materials and Methods

2.1 Experimental Materials

Beef, casing, compound phosphate, modified starch, honey, salt, five spice powder, cooking wine, edible oil, vacuum chopper, sausage maker, oven, constant temperature drying oven.

2.2 Experimental Method

2.2.1 Thawing Treatment

In this experiment, high-quality frozen beef was thawed in running water at room temperature.

2.2.2 Chopping and Mixing Treatment

After thawing, cut the beef into small pieces of one centimeter and put it into a chopper for chopping and mixing. The chopping and mixing time is ten minutes. During the chopping and mixing process, add 10% ice water in ten times with an interval of one minute.

2.2.3 Enema and Baking Treatment

After chopping and mixing, add compound phosphate (0.1%, 0.2%, 0.3%, 0.4%, 0.5%) [11], modified starch (1%, 1.5%, 2%, 2.5%, 3%), 0.5% honey, 1% five spice powder, 2% cooking wine, salt

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(1%,1.5%, 2%, 2.5%, 3%) and mix well. After mixing well, enema shall be carried out. During enema, enema machine shall be used for enema.

The length of post intestinal emulsified intestine is about 10 cm. Tie a knot with a rope in the middle, pierce the hole with a toothpick to vent air, and finally bake it in an oven at 120 ℃ for 1.5 h, turning it every half an hour. All indexes shall be tested after baking.

2.3 Detection of Emulsified Bowel Index

2.3.1 Determination of Water Content

The direct drying method is used to determine the water content. The emulsified sausage is accurately weighed and mixed with fine sand, and then put into a constant temperature drying oven to dry until the weight difference before and after constant weight is no more than 1 mg [12]. The temperature of the drying oven is 103 ± 2 ℃, and the sand particle size should be between 12 mesh and 60 mesh.

$$\text{water content} = \frac{m1 - m2}{m3 - m4} \times 100\%$$

m1 = total weight of emulsified intestines and fine sand and container after drying.

m2 = weight of fine sand and container after drying.

m3 = total weight of emulsified intestines and fine sand and container before drying.

m4 = weight of fine sand and container before drying.

2.3.2 Sensory Evaluation

Fifteen students who have received simple sensory training conducted sensory evaluation from four aspects of color, tissue state, flavor and tenderness by double-blind method. The scoring standard is nine point system, and the scoring standard is shown in the following table [13].

Properties	Measurement index.
Color:	The color is ruddy, bright and has the unique luster of sausage(7-9 min).
	The color is dark, the color is not bright, and there is no luster(3-6 min).
	The color is too dark or too white, and the color is dim(1-3 min).
Flavor:	It has unique fragrance, good taste and high acceptability(7-9min).
	The flavor is average, the taste is acceptable, and the overall quality is acceptable(4-6 min).
	The flavor is poor, the taste is difficult to accept, and the overall acceptance is difficult to accept(1-3 min).
Tissue state:	The emulsified intestine is tight inside, not loose, and there is no crack outside(7-9 min).
	The emulsified intestine is slightly loose inside and slightly cracked outside(4-6 min).
	Emulsified intestines are loose inside, with large cracks, and the appearance is difficult to accept(1-3 min).
Tenderness:	Moderate tenderness and high acceptability(7-9 min).
	The tenderness is weak or hard, and the acceptability is general(4-6 min).
	Tender too soft or too hard, low acceptability(1-3 min).

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2.4 Statistical Analysis

SPSS and origin are used for data processing and drawing graphics.

3. Results and Analysis

3.1 Effect of Salt on Emulsified Intestine Effect of Salt on Emulsified Intestine

3.1.1 Influence of Color

As shown in Figure 1, when the salt addition amount is 1.5%, the color perception evaluation is the best, but it is the same as the salt content.

There is no significant difference at 1%, but there is a significant difference when the salt content exceeds 1.5%, which indicates that a small amount of salt can increase the color acceptability of emulsified intestine, but excessive addition will reduce the color acceptability.

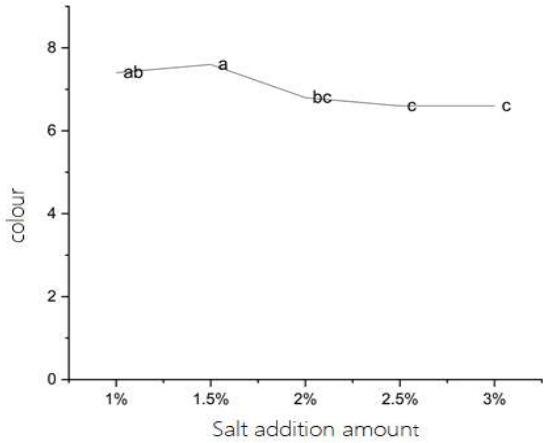

Fig. 1 Effect of salt content on color of emulsified intestine

*Those with the same letters indicated that the difference did not reach the significant level (P > 0.05), and those with different letters indicated that the significance reached the significant level (P > 0.05)

3.1.2 Influence of Flavor

The effect of salt addition on emulsified sausage is shown in Figure 2. The flavor evaluation has been increasing, and the salt content is increasing.

There was significant difference between 1% and 1.5%, but there was no significant difference when the salt content exceeded 1.5%.

It shows that a small amount of salt can optimize the flavor of salt, but the optimization effect becomes smaller when the salt content exceeds 1.5%.

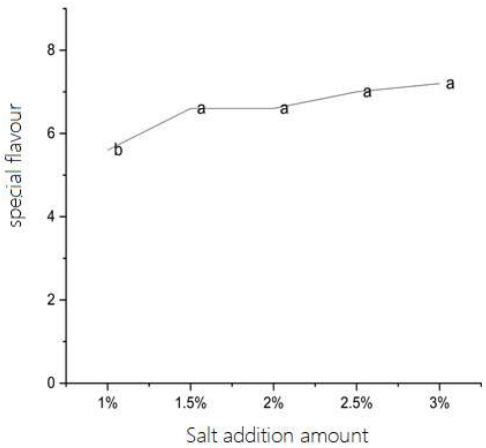

Fig. 2 Effect of salt content on flavor of emulsified sausage

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3.1.3 Influence of Organizational Status

The effect of salt addition on the tissue state of emulsified intestine is shown in Figure 3. With the continuous increase of salt addition, although the sensory evaluation of tissue state decreases overall, there is no significant difference, indicating that the addition of salt has no significant effect on the tissue state of emulsified intestine.

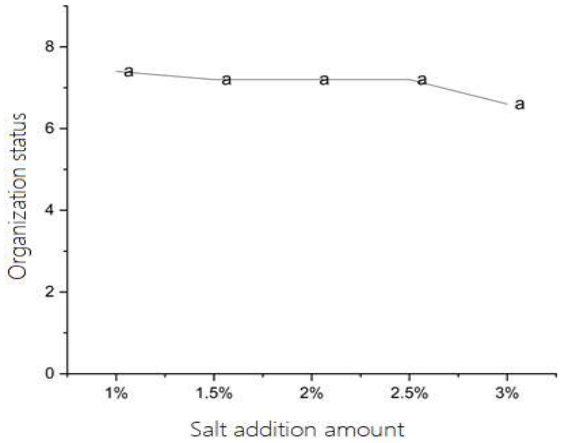

Fig. 3 Effect of salt content on tissue state of emulsified intestine

3.1.4 Influence of tenderness

The effect of salt addition on the tenderness of emulsified intestines is shown in Figure 4. The tenderness evaluation shows a trend of increasing first and then decreasing. There is a significant difference in tenderness between 1% and 1.5% of salt content, but the tenderness evaluation reaches the highest when the salt addition is 2%, indicating that moderate salt addition can effectively improve the tenderness of emulsified intestines.

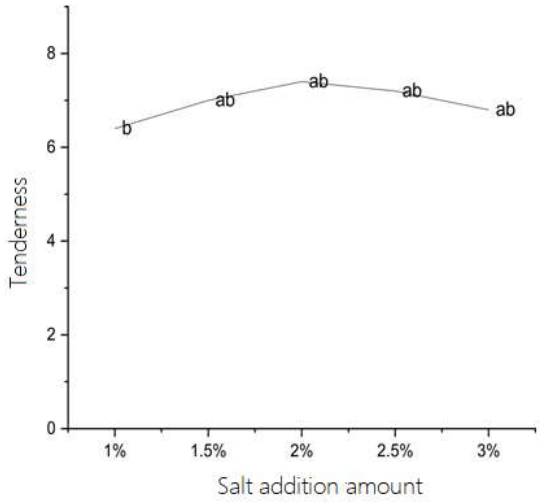

Fig. 4 Effect of salt content on color of emulsified intestine

3.1.5 Influence of Water Content

The effect of salt addition on the water content of emulsified intestine is shown in Figure 5. The water content increases first and then decreases with the addition of salt. The water content increases significantly when the salt content is 1% - 2%, 2%-2.5% water content decreased significantly, indicating that the addition of salt can effectively increase the water content of emulsified intestine, but when the experimental content exceeds 2%, it will reduce the water content of emulsified intestine.

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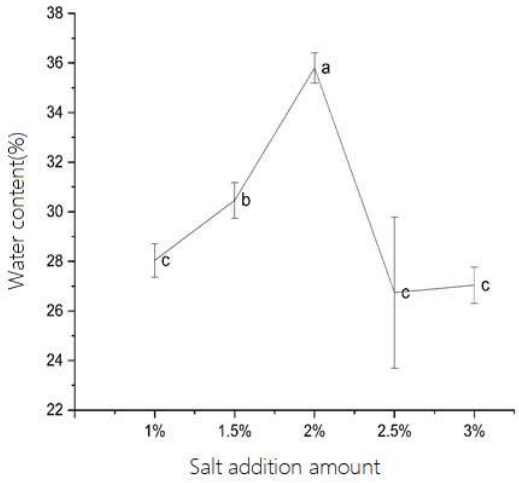

Fig. 5 Effect of salt content on water content of emulsified intestine

3.1.6 Summary

Table 1. Effect of salt addition on properties of emulsified intestine

Salt addition	Color	Taste	Tissue state	Tenderness	Water content(%)
1.00%	7.40^{ab}	5.60^{b}	7.40^{a}	6.40^{b}	28.04 ± 0.67^{c}
1.50%	7.60^{a}	6.60^{a}	7.20^{a}	7.00^{ab}	30.46 ± 0.71^{b}
2.00%	6.80^{bc}	6.60^{a}	7.20^{a}	7.40^{a}	35.80 ± 0.60^{a}
2.50%	6.60^{c}	7.00^{a}	7.20^{a}	7.20^{ab}	26.74 ± 3.04^{c}
3.00%	6.60^{c}	7.20^{a}	6.60^{a}	6.80^{ab}	27.04 ± 0.73^{c}

The results show that salt plays a very important role in the quality of emulsified intestine. When the salt content is 1.5%, the sensory evaluation is the best, which is 28.4; When the salt addition was 2%, the added value was the highest, which was 30.46%.

3.2 Influence of Compound Phosphate on Emulsified Intestine

3.2.1The Influence of Color

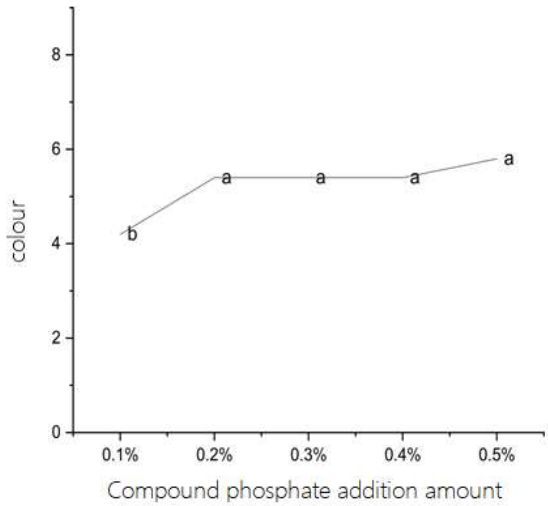

Fig. 6 Effect of compound phosphate content on color of emulsified intestine

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The influence of compound phosphate on the color of emulsified sausage is shown in Figure 6. The color evaluation of 0.1%-0.2% increases, but there is no significant difference between 0.2%-0.4% and a slight increase between 0.4%-0.5%, which indicates that the addition of conforming phosphate is helpful to increase the acceptability of emulsified sausage color, but the increment of color acceptability becomes smaller when it exceeds a certain amount.

3.2.2 Influence of Taste

The effect of compound phosphate on the flavor of emulsified sausage is shown in Figure 7. The flavor evaluation shows a significant increase in the content of compound phosphate between 0.1% - 0.3% and a significant decrease between 0.3% - 0.5%, indicating that compound phosphate has a strong effect on the flavor of emulsified sausage. Appropriate addition can effectively increase the flavor of emulsified sausage; However, excessive addition will reduce the flavor of emulsified sausage.

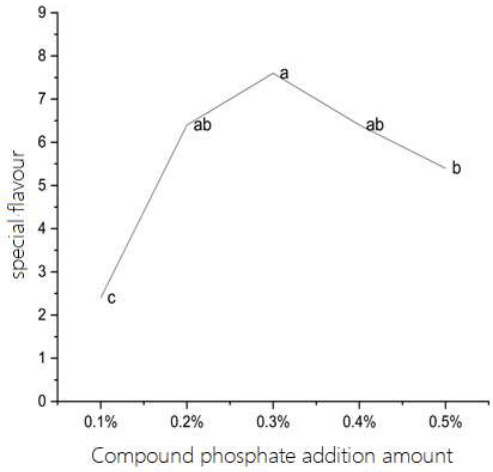

Fig. 7 Effect of compound phosphate content on flavor of emulsified sausage

3.2.3 Influence of Tissue State

The effect of compound phosphate on the tissue state of emulsified intestine is shown in Figure 8. There is no significant difference in the evaluation of tissue state between 0.1% - 0.3%, but there is a significant increase between 0.3% - 0.4% and a significant decrease between 0.4% - 0.5%. It shows that the effect on tissue state is small when the content of compound phosphate is low, However, when the concentration of compound phosphate reaches a certain level, the evaluation of tissue state will increase significantly, but if it exceeds a certain range, the tissue state will decrease significantly.

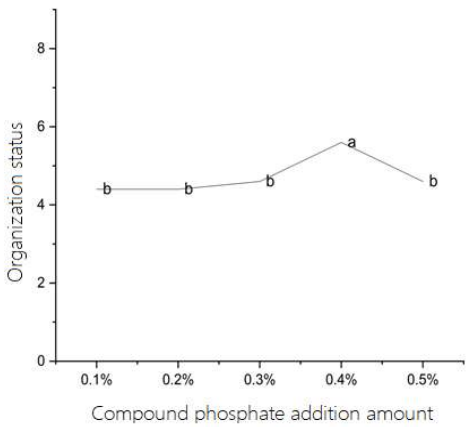

Fig. 8 Effect of compound phosphate content on tissue state of emulsified intestine

ISSN: 2414-1895 DOI: 10.6919/ICJE.202202_8(2).0041

3.2.4 Influence of Tenderness

The effect of compound phosphate on the tenderness of emulsified intestines is shown in Figure 9. Although the sensory indexes of tenderness change slightly with the addition of compound phosphate, there is no significant difference, indicating that compound phosphate has little effect on tenderness.

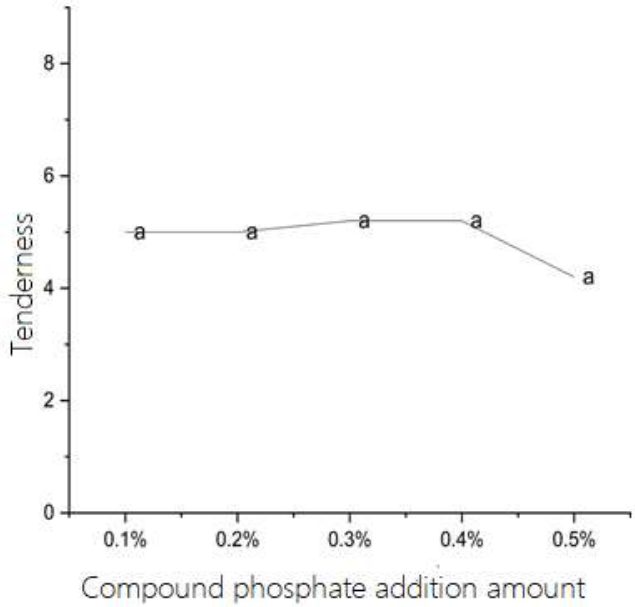

Fig. 9 Effect of compound phosphate content on tenderness of emulsified intestine

3.2.5 Influence of Water Content

The effect of compound phosphate on the water content of emulsified intestine is shown in Figure 10. The content of compound phosphate is 0.1%-the water content increased significantly between 0.4% and then decreased significantly after 0.4%, indicating that compound phosphate has a great impact on the water content of emulsified intestine. A certain amount of compound phosphate can effectively increase the water content of emulsified intestine, but excessive addition will reduce the water content of emulsified intestine.

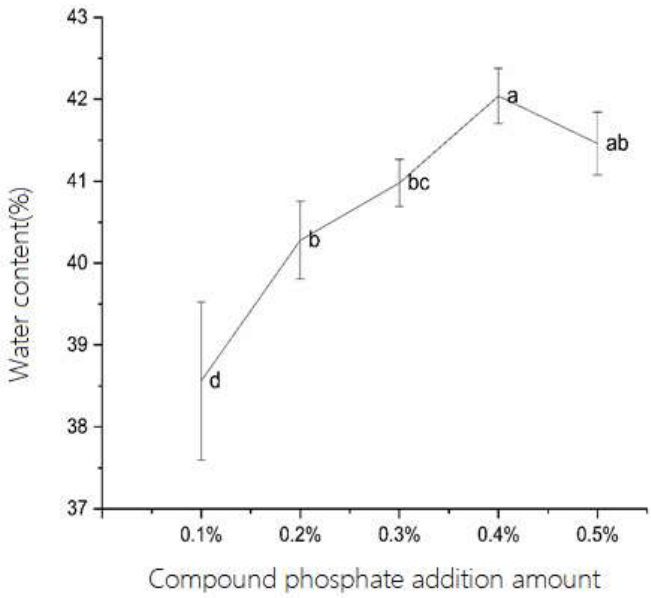

Fig. 10 effect of compound phosphate content on water content of emulsified intestine

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3.2.6 Summary

Table 2. Effect of compound phosphate on properties of beef emulsified sausage

Compound phosphate addition	Color	Taste	Tissue state	tenderness	Water content (%)
0.10%	4.20^{b}	2.40^{c}	4.40^{b}	5.00^{a}	38.56±0.97 ^{d}
0.20%	5.40^{a}	6.40^{b}	4.40^{b}	5.00^{a}	40.28±0.48 ^{b}
0.30%	5.40^{a}	7.60^{a}	4.60^{b}	5.20^{a}	40.98±0.29^{bc}
0.40%	5.40^{a}	6.40^{ab}	5.60^{a}	5.20^{a}	42.04±0.34 ^{a}
0.50%	5.80^{a}	5.40^{b}	4.60^{b}	4.20^{a}	41.46±0.38^{ab}

The effect of compound phosphate on emulsified intestine is shown in Table 2. When the addition amount of compound phosphate is 0.3%, the sensory evaluation is the highest, 22.8; When the content of compound phosphate was 0.4%, the added value of water content was the highest, which was 40.98%.

3.3 Effect of Modified Starch on Emulsification Field

3.3.1 Influence of Color

The effect of modified starch on the color of emulsified intestine is shown in FIG. 11, and there is significant difference between each addition amount.

However, the significance is not obvious, indicating that modified starch has an effect on the color of emulsified intestines, but the effect is not very obvious with the change of addition amount.

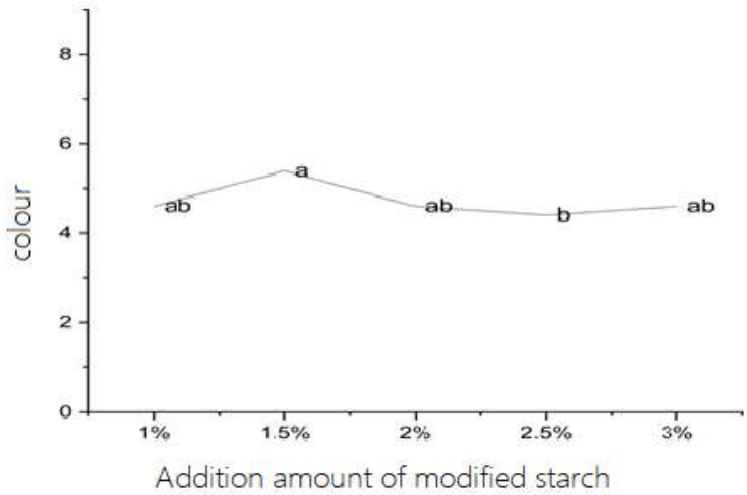

Fig. 11 effect of modified starch content on color of emulsified intestine

3.3.2 Influence of Taste

The effect of modified starch on the flavor of emulsified sausage is shown in Figure 12. The flavor evaluation increased significantly when the modified starch was 1% - 1.5%, and decreased significantly after 1.5% - 2%, and there was no significant difference between 2% - 3%. It shows that the appropriate addition of modified starch will increase the flavor of emulsified sausage, but too much or too little will decrease the flavor of emulsified sausage.

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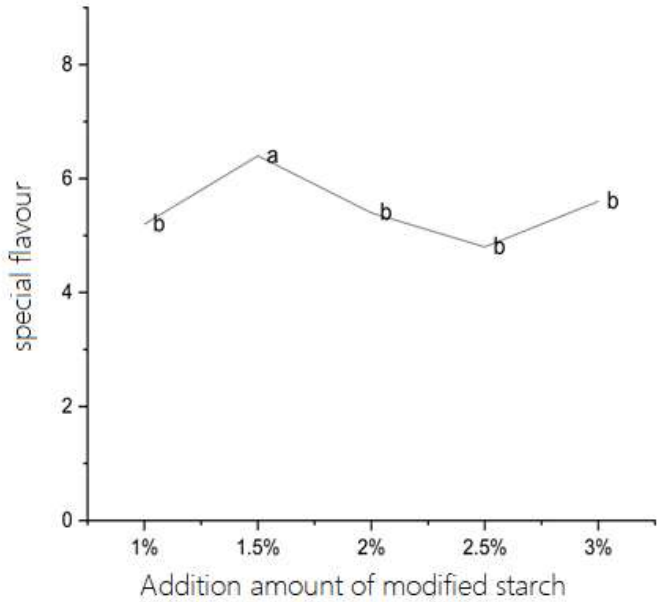

Fig. 12 effect of modified starch content on flavor of emulsified sausage

3.3.3 Influence of Tissue State

The effect of modified starch on the tissue state of emulsified intestines is shown in Figure 13. The tissue state of emulsified intestines increases significantly between 1% - 1.5% and there is no significant difference between 1.5% - 3%, indicating that a small amount of modified starch can optimize the tissue state of emulsified intestines, but there will be no significant difference in the tissue state of over added emulsified intestines.

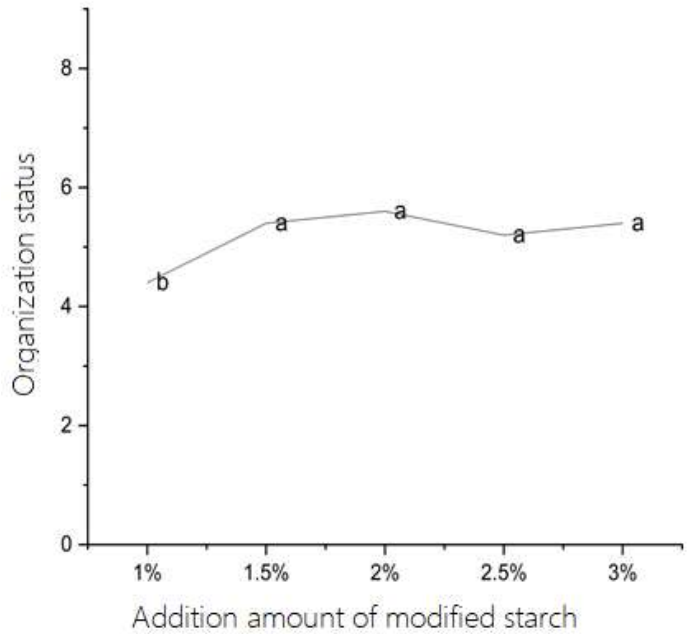

Fig. 13 effect of modified starch content on tissue state of emulsified intestine

3.3.4 Influence of Tenderness

The effect of modified starch on the tenderness of emulsified intestine is shown in Figure 14. Although the tenderness changes with the addition of modified starch, there is no significant difference, indicating that although modified starch has an impact on the tenderness of emulsified intestine, the impact is not great.

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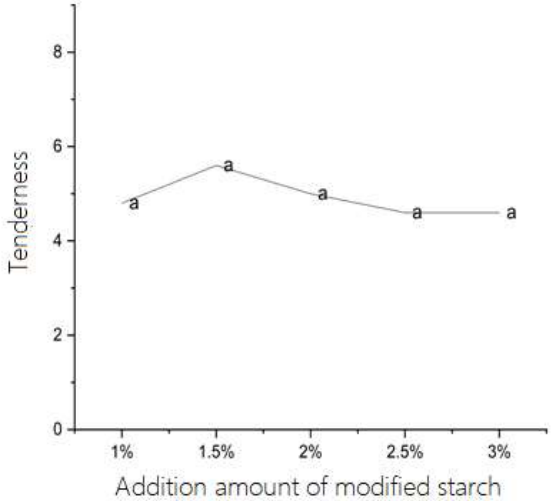

Fig. 14 effect of modified starch content on tenderness of emulsified intestine

3.3.5 Influence of Water Content

The effect of modified starch on emulsified intestine is shown in Figure 15. With the addition of modified starch, the water content increases significantly between 1% - 2% and decreases significantly between 2% - 3%. It shows that proper addition of modified starch is beneficial to increase the water content of emulsified intestine, but excessive addition of modified starch will reduce the water content of emulsified intestine.

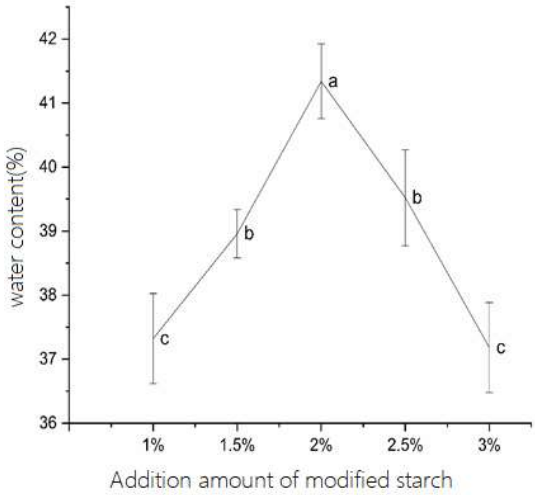

Fig. 15 effect of modified starch content on water content of emulsified intestine

3.3.6 Summary

Table 3. Effect of modified starch on properties of emulsified intestine

Modified starch addition	Color	Taste	Tissue state	tenderness	Water content(%)
1.00%	4.60^{ab}	5.20^{b}	4.40^{b}	4.80^{a}	37.32 ± 0.70^{c}
1.50%	5.40^{a}	6.40^{a}	5.40^{a}	5.60^{a}	38.96 ± 0.38^{b}
2.00%	5.40^{ab}	5.40^{b}	5.60^{a}	5.00^{a}	41.34 ± 0.59^{a}
2.50%	5.40^{b}	4.80^{b}	5.20^{a}	4.60^{a}	39.52 ± 0.75^{b}
3.00%	5.40^{ab}	5.60^{b}	5.40^{a}	4.60^{a}	37.18 ± 0.70^{c}

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As shown in Table 3, when the content of modified starch is 1.5%, the sensory evaluation is the highest, 22.8; When the content of modified starch was 2%, the added value was the highest, 38.96%.

3.4 Determination of the Optimal Amount of Auxiliary Materials

On the basis of single factor experiment, with sensory evaluation and water content as investigation indexes, orthogonal experiment was used to optimize table salt (a), polyphosphate (b) and modified starch (c) to determine the best addition process of emulsified intestinal excipients. The factors are shown in Table 4 and the results are shown in table 5.

Table 4. Influencing factors

Level		Factors	
	Salt	Compound phosphate	Modified starch
1	1.5%	0.3%	1.5%
2	1.75%	0.35%	1.75%
3	2%	0.4%	2%

*Sensory evaluation was the sum of color, flavor, tissue state and tenderness, with a total score of 36 points

Table 5. Orthogonal experiment table of auxiliary material addition

Group number		A	B	C	Empty column	Sensory evaluation	Water content(%)
1		1	1	1	1	31.33	36.52
2		1	2	2	2	30.19	34.98
3		1	3	3	3	29.56	33.25
4		2	1	2	3	30.45	34.45
5		2	2	3	1	29.65	30.74
6		2	3	1	2	31.58	32.31
7		3	1	3	2	29.65	28.94
8		3	2	1	3	31.79	30.86
9		3	3	2	1	30.75	29.67
	k1	30.36	30.48	31.26	30.58		
Sensory evaluation	k2	30.56	30.54	30.46	30.47		
	k3	30.73	30.63	29.62	30.60		
	R	0.37	0.15	1.64	0.13		
	k1	34.92	33.30	33.23	32.31		
	k2	32.50	32.19	33.03	32.08		
Water content	k3	29.82	31.74	30.98	32.85		
	R	5.09	1.56	2.25	0.78		
Sensory optimization level						A3B3C1	
Water content optimization level						A1B1C1	

ISSN: 2414-1895 DOI: 10.6919/ICJE.202202_8(2).0041

As shown in Table 4, when the sensory evaluation is taken as the index, the optimal addition process of emulsified intestinal adjuvant is a3b3c1, that is, when the salt content is 2%, the compound phosphate content is 0.4%, and the modified starch is 1.5%; When the water content is taken as the index, the optimal addition process of emulsified intestinal adjuvant is a1b1c1, that is, the salt content is 1.5% and the compound phosphoric acid.

The salt content was 0.3%, and the modified starch content was 1.5%. Because the premise of selecting the optimal formula in this experiment is the best taste, the optimal formula selected in this experiment is that the salt content is 2%, the compound phosphate content is 0.4%, and the modified starch is 1.5%.

4. Conclusion and Prospect

4.1 Conclusion

The sensory evaluation was the best when the salt content was 1.5%, and the added value was the highest when the salt content was 2%; When the content of compound phosphate was 0.3%, the sensory evaluation was the highest, while when the content of compound phosphate was 0.4%, the added value was the highest; The sensory evaluation was the highest when the content of modified starch was 1.5%, and the added value was the highest when the content of modified starch was 2%; According to the analysis of comprehensive test method, the optimal formula is that the salt content is 2%, the compound phosphate content is 0.4%, and the modified starch is 1.5%.

4.2 Prospect

In this experiment, the addition of auxiliary materials of beef emulsified sausage was explored, and the maximum added value was obtained when the maximum sensory evaluation was obtained. However, due to the limitations of experimental conditions and time, there are still some aspects worthies of further research and discussion: detect the prepared emulsified sausage and see how the auxiliary materials affect the added value of water content of emulsified sausage, Whether the original tissue structure of emulsified intestine has changed; Beef emulsified sausage is a consumption mode of beef. Whether it is convenient for the human body to fully absorb the nutrition of emulsified sausage after processing.

Thank-you-speech

The graduation thesis has been basically completed, and I have a lot to say in my heart, of which the most want to say is thank you. First of all, I would like to thank my tutor for his guidance and suggestions, and patiently modify my paper. When I don't know how to proceed to the next step in the experiment, I will be instructed to proceed to the next step smoothly. Under his strict guidance, I completed each part of the experiment rigorously and successfully completed the thesis. It can be said that in my whole experiment and thesis writing, the instructor has the greatest influence on me and continues to patiently guide me to the next step. Here I want to say thank you to the teacher.

The second thanks are my classmates, who encourage and support me in my daily study and life. They support me when I'm confused. It's lucky for me to be with you in my life.

During the completion of my graduation thesis, although I read a lot of literature and journals, because my level is really limited. Although I spent a lot of time and energy, there will still be some unnecessary mistakes. Please criticize and correct, thank you!

Acknowledgments

This project is supported by the key research and development plan of Zibo City in 2021 (the integration project of school and city in the city), with the project number of 2021SNPT0007; Guiding plan for technological innovation in Shandong province in 2020 (action plan for science and technology commissioners), project number: supported by 2020KJTPY053.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202202_8(2).0041

Reference

[1] Lu Jiaying Effect of edible gum on functional properties of myofibrillar protein and its application in emulsified intestine[D]. Northeast Agricultural University, 2012.

[2] Pirinya Wongwiwat, Saowakon Wattanachant, Sunisa Siripongvutikorn. Effect of phosphate treatments on microbiological, physicochemical changes of spent hen muscle marinated with Tom Yum paste during chilled storage. 2010, 90（8）: 1293- 1299.

[3] Tian Ruihua Effect of Polyphosphate on beef processing characteristics [D] Nanjing Agricultural University, 2012 [4] Review on the development of China's beef cattle industry in 2018 [J] China animal husbandry, 2019 (11): 20 – 23.

[4] Zhao Guanghui Effect of edible gum on the quality of smoked and boiled sausage [D] Henan Agricultural University, 2014.

[5] Zhang Yun, Bian Chunli, Zhang Yajuan, Yang Wangwang Effect of phosphate on water holding capacity of emulsified intestine [J] Modern food, 2017 (19): 104-106.

[6] Wang Peng, Xu Xinglian, Zhou Guanghong Effects of phosphate on water retention and texture properties of emulsified sausage during storage [J] Food industry science and technology, 2007 (06): 96-99.

[7] Zhao Chunbo, Zhang Qiuhui, Ma Changming, Li Miaoyun, Yu Xiaoling, Zhao renamed Effect of potassium chloride replacing part of salt on the quality of pork emulsified sausage [J] Meat industry, 2019 (01): 15 – 19.

[8] Bin Dongmei On Western meat products and new processing technology [J] Livestock and poultry industry, 2002 (11): 44 – 45.

[9] Shi Shuai, Chen Taotao Effects of composite water retaining agent and sodium isoascorbate on emulsifying properties of emulsified intestines [J] Food science and technology, 2020, 45 (02): 126 – 132.

[10] Wang Peng Effect of premixing before rigidity on water retention and texture properties of emulsified intestine [D] Nanjing Agricultural University, 2007.

[11] GBT9695. 15 - 2008, determination of moisture content in meat and meat products [S].

[12] Effects of Meat and Phosphate Level on Water-Holding Capacity and Texture of Emulsion-Type Sausage Duringr Storage[J]. Agricultural Sciences in China, 2009, 8（12）: 1475- 1481.