



## Factors affecting the processing of chicken breast and green chili (*Capsicum annuum*

### L.) Vietnamese steamed sausage (cha lua)

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#### ABSTRACT

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The main purpose of this research is to develop a process for producing green bird's eye chili chicken breast patties from new ingredients, contributing to diversifying patty products on the market. This study was carried out by investigating the following factors: the influence of grinding time (2 - 5 minutes) on raw chicken breast; sodium polyphosphate ratio (0 - 0.45%); sugar (1 - 3%) and gelatin (0 - 2%) ratio and steaming time (30 - 45 minutes) affect product quality. Research results showed that the appropriate grinding time was 3 minutes. The ratio of sodium polyphosphate was 0.45%, sugar was 2% and gelatin was 1% which would create a product with a stable structure. The steaming time to ensure microbiological standards was 40 minutes.

## 1. INTRODUCTION

Poultry meat production and consumption are continuously growing globally due to the healthy nutritional value of poultry meat (lower cost than beef and pork) and its suitability for food processing (Petracci et al., 2013). Furthermore, with increasing consumer awareness of healthy eating, low-fat meat products have become popular in the market (Desmond et al., 1998).

Skinless chicken breast, known for its high protein content and low fat, is considered a healthier alternative to red meat (Wang, 2017). Sims (2016) reported that nearly half of American consumers are now interested in non-beef burger alternatives. Among this half of consumers, 46% of the 50% are interested in chicken burgers and 42% of the 50% are interested in turkey burgers.

Ground chicken breast has become popular in the US market. Due to its low fat content, ground chicken breast has less favorable sensory quality characteristics, such as blandness and dryness, similar to what is observed in low-fat ground beef products. Williams and Damron (1998) suggested that cooked chicken breast is less juicy than chicken thigh, which has a relatively higher fat content. Similarly, Sogunle et al. demonstrated that chicken breast is consistently rated lower than thigh meat in sensory attributes such as tenderness and juiciness. To improve the sensory quality of low-fat ground meat products, vegetable starch and/or flour are often used as binders and/or fillers (Bolger et al., 2017).

Among plant-based starches or binders, flour is one of the most commonly used products in ground meat (Petracci et al., 2013). Many studies have shown that incorporating flour in meat products alters physical properties, sensory texture, and flavor attributes. Hughes et al. (1998) added tapioca starch to frankfurters and found that this starch reduced cooking loss and increased emulsion stability as well as overall flavor intensity. In addition, the grinding and mixing process continuously applies mechanical force to ground meat, causing protein denaturation and the formation of gel networks. The mechanical force causes actin and myosin fibers to slide over each other, creating internal friction that breaks down secondary, tertiary, and quaternary structures, straightens proteins, and forms gel network nodes, giving the sausage elasticity and firmness. However, the grinding and mixing time with additives must be specific; if the grinding time is too long, it will create a large frictional force during grinding due to the very high speed of the grinder, which will reduce

the internal moisture of the sausage block and the protein's binding capacity, and the color of the sausage will decrease. Conversely, if the mixing time is too short, the gel network will not form, reducing gel strength. Furthermore, steaming is a method of cooking ingredients directly with hot steam. After preparation, ingredients are placed in specialized equipment, not in contact with water. Water in the equipment is heated to form steam, and the hot steam directly cooks the ingredients. The heat transfer process for cooking food is divided into three stages: fire transfers heat to water, causing it to boil; boiling water turns into steam; and steam transfers to the ingredients, cooking them.

Ground chicken breast, low-fat products are relatively new products. Currently, there is very little information on the effect of grinding time, additives, and steaming time on their quality. The objective of this study is to evaluate the impact of grinding, additive incorporation, and steaming time on both the physicochemical characteristics and sensory quality of ground chicken breast patties to establish a processing procedure for this new product type.

## **2. RESEARCH METHODS**

### **2.1 Experimental design**

Fresh chicken breast was purchased from supermarkets such as GO, CO.OP Mart, and Bach Hoa Xanh, etc., in the morning to ensure the freshness of the meat. The meat was immediately washed under clean water and drained. After cleaning, the ingredients were quick-frozen in a freezer or cold storage at -18oC for 8-10 hours. Next, the ingredients were coarsely ground, and structural additives and fresh green bird's eye chili (fresh and green fruits purchased from the aforementioned supermarkets) were added at this

stage. All ingredients were then finely ground (2 - 5 minutes), seasonings (salt, fish sauce with sodium polyphosphate ratio (0 - 0.45%); sugar (1 - 3%) and gelatin (0 - 2%) were added, and grinding continued until the desired time was reached to enhance the gelling ability of the meat. After grinding, the sausage mass was shaped and maintained at a temperature below 12 °C. The sausage mass was divided into smaller portions, each weighing 500g, and placed into molds before steaming in a steamer at 98-100°C for 30 - 45 minutes. After steaming, the product was immediately put into PA packaging and vacuum-sealed.

**2.2 Analytical methods**

Sensory evaluation of taste, state, and structure of the product was performed according

to Vietnamese standard TCVN 3215-79. For the scoring method according to TCVN 3215-79, a unified 6-level, 5-point scale (0-5) was used, where 0 corresponds to a spoiled product and 1-5 correspond to gradually decreasing product quality. The method for measuring slice bending strength was performed according to National Standard TCVN 8682:2011 Frozen Surimi. pH value was determined using a portable pH meter (HI2210, HANNA, Italy). oBrix was measured using a portable refractometer (Master Refractometer, Atago, Japan). All measurements were performed at room temperature (28±2oC). Some other analytical methods used in this study are also presented in Table 1.

**Table 1. Analyzed parameters and corresponding methods in the entire experiment**

Parameter	Equipment used	Method
Moisture content (%)	Moisture analyzer (A&D MX-50, Japan, weighing resolution 0.001g, moisture accuracy: >1g: 0.1%)	Drying at 105 °C to constant weight
Lipid content (%)	Soxhlet extraction system	Soxhlet
Ash content (%)	Muffle furnace Nabertherm HTC08/14, Germany	Ashing until the sample becomes white or dark grey ash
Texture (g force)	Food texture analyzer (CT3–1000, Brookfield, USA) with resolution of 0.1 mm, error ± 0.1 mm, stroke speed 0.1-10 mm/s, speed error 0.01 mm/s and using specialized probe model TA 4/100 to determine the chewiness (g force) of "cha lua" at room temperature.	
<i>Clostridium perfringens</i> (CFU/g)		TCVN 4991:2005

Parameter	Equipment used	Method
<i>Salmonella</i> (CFU/g)		TCVN 10781-1:2017
<i>E. coli</i> (CFU/g)		NMKL 125:2005
Total coliform (CFU/g)		TCVN 6848:2007
Total yeast-mold (CFU/g)		TCVN 8275-1:2010

### 2.3 Data processing

The collected data were statistically processed using analysis of variance (ANOVA) with LSD test through Statgraphics Centurion XVI software at 95% confidence ( $p < 0.05$ ) to determine the significant differences between experiments, thereby selecting the optimal parameters. Mean values and standard deviations were also calculated using Microsoft Excel software.

## 3. RESULTS AND DISCUSSION

The chicken breast used in this study had a moisture content of 69.7%, lipid content of 1.3%, and ash content of 1.1%. Additionally, according to the National Institute of Nutrition (2007), the nutritional composition of chicken breast (100g edible portion) includes 0g sugar, 1g fat, 23g protein, and 110 kcal. The fat and cholesterol content in skinless chicken breast is very low (Vietnam National Institute of Nutrition, Ministry of Health, 2007).

### 3.1 Topic 1: Effect of grinding time on raw meat quality

Both moisture content and texture of the sausage mass were significantly affected by grinding time (Table 2). When grinding time was extended from 2 to 5 minutes, the moisture content of the sausage mass decreased from  $67.48 \pm 0.37\%$  to  $61.21 \pm 0.3\%$ . Similarly, the texture of the sausage mass also became firmer with prolonged grinding time. However, at grinding times of 4 minutes and 5 minutes, there

was no significant difference in the sausage mass texture, with values of  $476.6 \pm 13.0$  and  $470.3 \pm 10.1$  g force, respectively. During grinding, due to the very high grinding speed, grinding for too long will break down the protein structures of the sausage mass. Additionally, the high grinding speed generates frictional force, leading to an increase in the temperature of the sausage mass, which will reduce the water content inside the sausage mass, causing it to become dry. As grinding time increases, the fineness of the sausage mass significantly increases due to increased destruction of muscle fiber structures, leading to an increase in protein gel network nodes. Furthermore, increasing fine grinding time also helps muscle protein completely relax, increasing the opportunity for protease enzymes to interact with muscle protein, thereby improving the firmness and cohesiveness of the muscle. Short grinding time will not be enough to make the sausage mass fine, the raw meat material will not be completely homogeneous, the protein structure will not be broken down, and the gelling ability of the sausage will be poor. The finished product will not be firm enough to maintain its shape. Grinding for too long will lead to a decrease in the gelling ability of protein, and also a decrease in the moisture content of the sausage. This results in a dry and hard texture for the sausage, lacking softness (Vo Thi Kien Hao et al., 2021).

**Table 2. Effect of grinding time on moisture content and texture of sausage mass**

Grinding Time (minutes)	Description	Moisture (%)	Texture (g/force)
2	Fragile sausage structure, not smooth	67.48±0.37 <sup>a</sup>	353.0±23.5 <sup>c</sup>
3	Smooth sausage structure, but still quite fragile	64.49±0.36 <sup>b</sup>	395.0±8.1 <sup>b</sup>
4	Slightly chewy, soft sausage structure	62.94±0.16 <sup>c</sup>	476.6±13.0 <sup>a</sup>
5	Slightly chewy, not soft sausage structure	61.21±0.3 <sup>d</sup>	470.3±10.1 <sup>a</sup>

Note: Different letters in the same column indicate statistically significant differences according to the LSD test at 5%

**3.2 Topic 2: Effect of added sodium polyphosphate ratio on product quality**

After slaughter, meat tends to lose water, and the presence of polyphosphate increases the pH of the product. They act on muscle fibers, increasing the water-holding capacity of the muscle. As a result, hydration increases, and protein absorbs and retains water, leading to an increase in product moisture. As the amount of polyphosphate gradually increases, the moisture and pH of the product in each sample also gradually increase. This leads to a tighter product structure, contributing to an increase in the sensory value of the product (Dao et al., 2003).

The results shown in Table 3 and Figure 1 indicate that the added sodium polyphosphate ratio significantly affects the texture of the sausage mass. For sausages without phosphate addition, the finished product still had gelling

ability and protein linkage, but it was very poor; when tested by slice bending, 5/5 sausage slices immediately broke but did not break off. Conversely, the sample with 0.15% phosphate addition showed a clear improvement in product texture compared to the control without addition, but it still did not produce a good effect when testing slice bending strength. The sausage sample with 0.3% phosphate addition showed good quality of the finished sausage with good chewiness and softness, but when testing the slice bending strength of 5 slices, one slice still showed cracks. Finally, the sausage sample with 0.45% phosphate addition clearly demonstrated the gelling ability of sodium polyphosphate. The sausage was very chewy and soft. Testing the sample by slice bending resulted in folding the sausage slice into quarters without any cracks.

**Table 3. Effect of added sodium polyphosphate ratio on sausage mass texture**

Sodium Polyphosphate ratio (%)	Description	Slice bending strength	Texture (g/force)
0	Sausage has a slightly chewy texture, folding in half causes cracks but remains attached	C	478.3 <sup>d</sup> ±17.2

0,15	Sausage has a chewy texture but all 5 slices have slight cracks	B	525.3 <sup>c</sup> ±8.7
0,3	Sausage has a chewy texture but 1 out of 5 slices has a slight crack	A	574.3 <sup>b</sup> ±11.9
0,45	Very chewy, soft sausage, and all 5 slices do not crack when folded in quarters	AA	614.0 <sup>a</sup> ±16.0

Note: Measurement method according to National Standard TCVN 8682:2011 Frozen Surimi

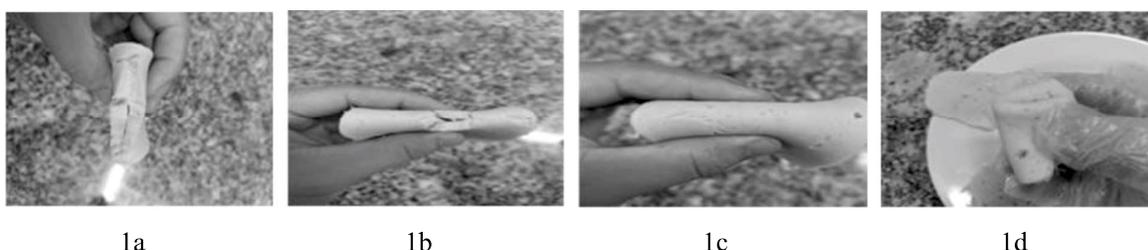


Figure 1. Slice bending strength of sausage mass at different added sodium polyphosphate ratios

Note: Added sodium polyphosphate ratios: 1a. 0%; 1b. 0.15%; 1c. 0.3%; and 1d. 0.45%.

**3.3 Topic 3: Effect of added sugar – gelatin ratio on product quality**

The research results in Table 4 clearly show the ability of gelatin to improve product structure. Besides, sugar is an additive that provides sweetness to the product but also contributes to improving the structure due to its physical properties, softening the product by reducing the

hardening effect of salt, and slightly hindering moisture migration. Sausage products with gelatin addition showed a clear difference in structure compared to the control sample. However, when the added gelatin ratio increased to 2%, the ability to improve product structure showed no difference compared to the 1% gelatin addition ratio.

Table 4. Effect of added sugar – gelatin ratio on product texture (g force)

Gelatin ratio (%)	Sugar ratio (%)			Average
	1	2	3	
0	616.3 <sup>c</sup>	611.6 <sup>c</sup>	611.6 <sup>c</sup>	613.2 <sup>b</sup>
1	674.6 <sup>a</sup>	668.6 <sup>a</sup>	660.3 <sup>ab</sup>	668.0 <sup>a</sup>
2	676.3 <sup>a</sup>	671.6 <sup>a</sup>	674.6 <sup>a</sup>	674.2 <sup>a</sup>
Average	655.7 <sup>a</sup>	650.6 <sup>a</sup>	649.0 <sup>a</sup>	

Note: Letters accompanied by different treatment means in the same column or row indicate significant differences at 5% level

The sensory scores for product taste are clearly shown in Table 5. The research results indicated that the added gelatin ratio did not affect the sensory value of the product's taste. At a 1% added sugar ratio, the product had a sweet

taste but was quite bland. Subsequently, with 2% sugar added, the product had a harmonious and rich taste. Finally, with 3% sugar added, the product had a rather harsh sweet taste and a poor sensory score.

Table 5. Effect of the added sugar–gelatin ratio on the sensory value of the product taste

Gelatin ratio (%)	Sugar ratio (%)			Average
	1	2	3	
0	3.5 <sup>b</sup>	4.6 <sup>a</sup>	3.2 <sup>c</sup>	3.7 <sup>a</sup>
1	3.6 <sup>b</sup>	4.7 <sup>a</sup>	3.2 <sup>c</sup>	3.8 <sup>a</sup>
2	3.5 <sup>b</sup>	4.5 <sup>a</sup>	3.3 <sup>bc</sup>	3.8 <sup>a</sup>
Average	3.5 <sup>b</sup>	4.6 <sup>a</sup>	3.2 <sup>b</sup>	

Note: Letters accompanied by different treatment means in the same column or row indicate significant differences at 5% level

Additionally, Table 6 also shows the sensory values for product texture. The results indicated that the sugar ratio added in this experiment did not affect the product's texture. Different gelatin ratios showed clear differences in texture

compared to the control sample. When gelatin was added up to 2%, the data showed no difference in texture score compared to the sample with 1% gelatin.

**Table 6. Effect of added sugar – gelatin ratio on the sensory value of product texture**

Gelatin ratio (%)	Sugar ratio (%)			Average
	1	2	3	
0	3.8 <sup>b</sup>	3.6 <sup>b</sup>	3.6 <sup>b</sup>	3.6 <sup>b</sup>
1	4.6 <sup>a</sup>	4.6 <sup>a</sup>	4.3 <sup>ab</sup>	4.5 <sup>a</sup>
2	4.6 <sup>a</sup>	4.4 <sup>a</sup>	4.4 <sup>a</sup>	4.4 <sup>a</sup>
Average	4.3 <sup>a</sup>	4.2 <sup>a</sup>	4.1 <sup>a</sup>	

Note: Letters accompanied by different treatment means in the same column or row indicate significant differences at 5%

**3.4 Topic 4: Effect of steaming time on product quality**

Steaming is a process that cooks the product and simultaneously eliminates most food spoilage microorganisms, helping to improve shelf life. The results in Table 7 show that the total number of unfavorable microorganisms in the product after steaming for 30 minutes, primarily yeast-mold cells, could still be active at a 10<sup>2</sup> dilution. Clostridium perfringens,

Salmonella, total Coliform, and Escherichia coli were not found in the analyzed samples. Subsequently, at 35 minutes of steaming, yeast-mold cells were still found at a 10<sup>1</sup> dilution. However, after 40 and 45 minutes of steaming, most of the aforementioned microorganisms were not detected at different dilution concentrations. In addition, the basic chemical composition of green chili chicken breast sausage was also found, and the results are shown in Table 8.

**Table 7. Effect of steaming time on the microbiological safety of sausage product**

Steaming time (minutes)	Type of microorganism	Unit	Test method	Result
30	<i>Clostridium perfringens</i>	CFU/g	TCVN 4991:2005	None
	<i>Salmonella</i>	CFU/g	TCVN 10781-1:2017	None

Steaming time (minutes)	Type of microorganism	Unit	Test method	Result
35	<i>Escherichia coli</i>	CFU/g	NMKL 125:2005	None
	Total coliform	CFU/g	TCVN 6848:2007	None
	Total yeast-mold	CFU/g	TCVN 8275-1:2010	1,1.10 <sup>2</sup>
	<i>Clostridium perfringens</i>	CFU/g	TCVN 4991:2005	None
	<i>Salmonella</i>	CFU/g	TCVN 10781-1:2017	None
	<i>Escherichia coli</i>	CFU/g	NMKL 125:2005	None
40	Total coliform	CFU/g	TCVN 6848:2007	None
	Total yeast-mold	CFU/g	TCVN 8275-1:2010	1,3.10 <sup>1</sup>
	<i>Clostridium perfringens</i>	CFU/g	TCVN 4991:2005	None
	<i>Salmonella</i>	CFU/g	TCVN 10781-1:2017	None
	<i>Escherichia coli</i>	CFU/g	NMKL 125:2005	None
	Total coliform	CFU/g	TCVN 6848:2007	None
45	Total yeast-mold	CFU/g	TCVN 8275-1:2010	None
	<i>Clostridium perfringens</i>	CFU/g	TCVN 4991:2005	None
	<i>Salmonella</i>	CFU/g	TCVN 10781-1:2017	None
	<i>Escherichia coli</i>	CFU/g	NMKL 125:2005	None
	Total coliform	CFU/g	TCVN 6848:2007	None
	Total yeast-mold	CFU/g	TCVN 8275-1:2010	None

**Table 8. Some chemical components of chicken sausage product after steaming**

Component	Content
Moisture (%)	63.1
Lipid (%)	3.33
Ash content (%)	1.42
pH	7.15
Brix	17.1

**4. CONCLUSION**

The processing procedure for green chili chicken breast sausage is designed with optimal parameters including a best grinding time of 4 minutes to achieve the best paste structure after

steaming. The optimal added sodium polyphosphate ratio is 0.45%, and the optimal sugar and gelatin ratios are 2% and 1%, respectively. In this study, the best steaming time for approximately 500g of sausage is 40 minutes.

**REFERENCES**

Bolger, Z., Brunton, N. P., Lyng, J. G., & Monahan, F. J. (2017). Comminuted meat products – consumption, composition, and approaches to healthier formulations. *Food Reviews International*, 33, 143–166. DOI: 10.1080/87559129.2016.1149861.

- Desmond, E. M., Troy, D. J., & Buckley, D. J. (1998). The effects of tapioca starch, oat fibre and whey protein on the physical and sensory properties of low-fat beef burgers. *LWT - Food Science and Technology*, 31, 653–657. DOI: 10.1006/fstl.1998.0415.
- Dao, T. Q., Nguyen, T. L., & Ha, T. A. D. (2003). *Experimental study on PDP (chitofood) as a food additive in the production of Vietnamese pork sausage and steamed rice rolls*. The 2nd Scientific Conference on Food Hygiene and Safety, 198–202.
- Hughes, E., Mullen, A. M., & Troy, D. S. (1998). Effects of fat level, tapioca starch and whey protein on frankfurters formulated with 5% and 12% fat. *Meat Science*, 48, 169–180. DOI: 10.1016/S0309-1740(97)00087-9.
- Petracci, M., Bianchi, M., Mudalal, S., & Cavani, C. (2013). Functional ingredients for poultry meat products. *Trends in Food Science & Technology*, 33, 27–39. DOI: 10.1016/j.tifs.2013.06.004.
- Sims, B. (2016). *Burger popularity endures, evolves*. [http://www.meatpoultry.com/articles/news/home/Business/2016/05/Burger popularity enduresevol.aspx?ID={B6E2EC39-5CF1-40E4-B9A9-C2AC6B6EDE64}&e=hong.zhuang@ars.usda.gov](http://www.meatpoultry.com/articles/news/home/Business/2016/05/Burger%20popularity%20enduresevol.aspx?ID={B6E2EC39-5CF1-40E4-B9A9-C2AC6B6EDE64}&e=hong.zhuang@ars.usda.gov). Truy cập ngày 4/4/2024.
- Sogunle, O. M., Egbeyale, L. T., Alajo, O. A., Adeleye, O. O., Fafiolu, A. O., Onunkwor, O. B., Adegbite, J. A., & Fanim, A. O. (2010). Comparison of meat composition and sensory values of two different strains of broiler chickens. *Archivos de Zootecnia*, 59, 311–314. DOI: 10.21071/az.v59i226.4749.
- TCVN 8682:2011. (2011). Frozen surimi. Vietnam National Institute of Nutrition, Ministry of Health. (2007). *Vietnamese food composition table*. Medical Publishing House.
- Vo, T. K. H., Pham, T. C., Phan, C. T., & Phan, H. T. (2021). The effects of grinding time, temperature, and frying time on the quality of tilapia fish cakes. *Journal of Scientific Research and Economic Development of Tay Do University*, 11, 228–240.
- Wang, B. (2017). *Broiler production and meat quality*. Canadian Poultry. <https://www.canadianpoultrymag.com/production/meat-broilers/broiler-production-and-meat-quality-30101>. Truy cập ngày 4/4/2024.
- Williams, S. K., & Damron, B. L. (1998). Sensory and objective characteristics of broiler meat from commercial broilers fed rendered whole-hen meal. *Poultry Science*, 77, 329–333. DOI: 10.1093/ps/77.2.329. DOI: 10.1093/ps/77.2.329