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Quality Characteristics of Processed Meat Products by Spices

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Abstract

Processed meat products are prone to oxidation and spoilage due to prolonged storage. By using natural spices that are harmless to the human body and have antioxidant and antibacterial effects to replace synthetic preservatives in consideration of consumers' qualitative consumption patterns that pursue nutrition and safety, and stimulate appetite with taste, aroma, and color of food. The purpose of this study was to study the effect on the quality characteristics of processed meat products. The spice group had a low crude fat for both the loin and sirloin cuts. Brightness, redness, and yellowness in the chromaticity of beef jerky and PYUNYUK added with spices were different from those of the control group and increased. In terms of texture, all the beef jerky groups increased firmness and friability, and there was a difference between refrigeration and room temperature storage. The elasticity and stickiness decreased with the lapse of storage period. In the PYUNYUK, the flavor of the spice group was low and the meat quality was soft. It was found that the addition of natural spices to replace synthetic preservatives had different effects on processed meat products and had a positive effect on general ingredients, mechanical properties, physicochemical properties, and sensory quality properties.

Keywords: Processed Meat, PYUNYUK, beef jerky, Spice Group

Major classifications: Food Nutrition, Healthy Food

1. Introduction

Our people have been good at hunting since ancient times and handled meat well. The history of meat processing has been developed to improve storability, and at the beginning it was stored by grilling or roasting, and then the method of drying meat marinated in salt or soy sauce was develop (Lee, 2003; Lee, 1985). The development of meat processing technology has been developed to increase the storability of raw meat that can be eaten for a long time without spoiling, and the types and manufacturing methods of meat products are different according to differences in society, food culture, religion, climate (Lee, 1992).

As a result of economic growth resulting in consumers' income increase, education level improvement, and changes in values, the diet is changing to a qualitative consumption pattern that pursues the nutrition and safety obtained from meat itself, as well as the amount of meat and products consumed (Lee & An, 2007). In addition, due to the influence of the COVID-19 incident, home cook (cooking at home) and camping trends are spreading, attracting attention to meat processing convenience foods that can be easily cooked. The Ministry of Agriculture, Food and Rural Affairs and the Korea Rural Economic Research Institute conducted a 2020 processed food consumer attitude survey of 2002 households with major food purchasers last year. It increased by 5.3% compared to the previous year. As for the top items for each household's purchase of processed food, processed meat ranked second, showing a lot of consumption. In addition, the meat processing and storage processing industry of shipments by food manufacturing industry showed a 65% growth trend in 2018 compared to 2012 (Jeong, 2021).

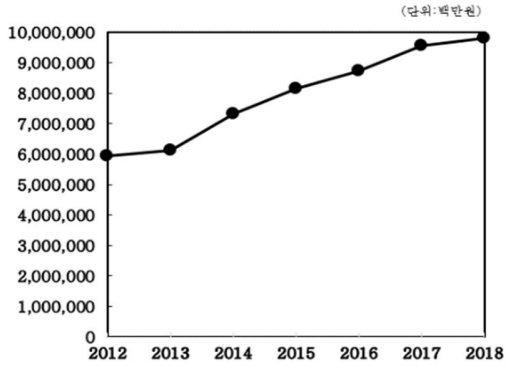

Figure 1: Shipment for slaughter, meat processing and storage treatment industries

Spice is a generic term for spice plants grown in temperate regions and spice produced in tropical and subtropical regions, in English, epice in French, and gewarz in German. It can be defined as all of the plants used as spices for preservation or health enhancers in food or beverages, and plants that are used in anticipation of perfume, makeup, and cleaning effects of products, in addition to food and beverages. In addition, dried medicinal plants using leaves, stems, roots, and flower buds of perennial plants are herbs, and those made with hard parts such as seeds, stems, skins, and fruit cores into powder form are called spice (Lee, 1995; Jang & Kim, 1999).

Herbs and spices enhance the taste, aroma, and color of food, and how to use them varies according to dietary habits and traditions in each country, but the function of spices is gradually emphasized now. In England, sage is used for pork, mint is used for lamb, and in Italy, basil, tomatoes and rosemary are used for lamb. Parsley, white wine, and basil are often used in fish dishes, and rosemary, bay leaves, parsley, paprika, thyme, cloves, and ginger are used in meat dishes. In addition, spices are rich in vitamins and minerals, contain pharmacological ingredients, and have digestion, astringent, diuretics, and antibacterial effects, so they are used for treatment and health maintenance, and are used for cooking to supply nutrients and health promotion (Park, 1996; Choi, 1992). Cloves and rosemary are important spices that are widely used around the world. The Syzygium aromaticum is the drying of the stamen of evergreen trees belonging to Myrtaceae. Dry flower chains are called cloves because they are shaped like chisels. Cloves contain a lot of phenol-like fragrance ingredients, so they are resistant, anthelmintic, and have local anesthesia, and are effective in enhancing appetite, and are widely used as spices for ham, sausage, bread, snacks, sauces, seasonings (Cho, 1992).

Rosemary L. is a type of miscellaneous tree that blooms purple flowers and grows naturally along the Mediterranean coast, and is a herb with a strong flavor similar to that of the camphor on its pointed leaves like pine leaves. The leaves are used as

they are, dried, or ground dried. Dried ones are mostly used for flavoring meat dishes, especially for roasting or stewing lamb and pork. Rosemary has long been used as a perfume and medicine, and it is known to increase the preservation of food by its role as a deodorant to remove odors, a refreshing fragrance, sterilization, antibacterial and antioxidant functions (Lee, 2007; Ibanez et al., 2000).

Processed meat products are an important source of animal protein, but they are prone to oxidation and spoilage with prolonged storage. The use of synthetic preservatives and antioxidants with advantages such as simplicity, economy, and diversity is increasing significantly in order to suppress oxidation, decay, and storage period of meat products. However, since the use of synthetic preservatives is limited and harmful to the human body, many consumers are questioning safety (Choi, & Rhim, 2008). Accordingly, the meat processing industry continues to pursue the development of high-quality products and new products that meet the needs of consumers using spices (Lee, 2003). Therefore, as a natural product that is harmless to the human body, the effect on the quality characteristics of processed meat products was investigated by using natural spices that exhibit antioxidant properties and stimulate appetite with the taste, aroma, and color of food. It was intended to develop a health-oriented product that can satisfy both functionality that suppresses the oxidation of meat products and sensual preferences in the future, and was investigated and organized to use it as basic data for the development of Korea's own specialized meat processing products using spices.

2. Research method

In this study, according to the order suggested by Lee (2007), a review was prepared on the research related to the quality effect of processed meat products by the addition of spices. In the first step, the contents and methods to study the effect of spices on processed meat were planned. In the second step, related literature was searched and investigated. In the third stage, research and selected papers were presented based on the research background. In step 4, the contents to be explained through this paper were objectively organized through the analyzed data. The last five steps were finally concluded based on the interpretation and analogy of the data. The period of search and organization of the results of this document was from March 11, 2021 to October 15, 2021, and the RISS Academic Research Information Service (http://m.riss.kr/index.do), and Google Academic Search (https://scholar.google.co.kr/schhp?hl=ko)) were used for literature search. As the keywords of the literature search, the main keywords were 'spice' and 'processed meat', and related keywords were mixed search terms such as antioxidant properties, quality comparison according to storage conditions, and sensory characteristics. The presentation period of search papers was a summary of papers from 1987 to 2007 and article data from 2021. In about 50 papers, 25 papers and materials were organized and a general theory was prepared.

3. Results and Discussion

3.1. General ingredients

3.1.1. Beef Jerky

Table 1 shows the results of analyzing the general components of the spice group. The moisture content was 18.9-21.2% in the spice group, higher overall than 18.1% in the control group, and the rosemary-added group was higher among the spice groups. The crude protein content differed according to the type of spice, and the control group had the highest at 64.7%. The crude fat content was 7.8% in the clove-added group, and showed a tendency to decrease as the crude protein content increased. Spice group was higher than control group. In the spice group, the rosemary-added group showed high levels of moisture and raw flour, the clove-added group showed the highest crude fat, and the clove-added group showed the lowest crude protein.

Table 1: Compositions in beef jerky prepared with various spices (unit: %)

Sample	Control	Rosemary	Clove
Moisture	18.1±1.5	21.2±1.7	18.9±3.2
Crude protein	64.7±2.8	60.3±2.7	58.9±3.2
Crude fat	6.4±2.0	6.9±2.4	7.8±1.8
Crude ash	6.5±2.7	7.5±1.5	6.8±2.5

3.1.2. PYUNYUK (traditional Korean dish, which consists of thinly sliced meat that has been boiled and pressed)

Table 2 shows the results of measuring the content of general components of shank PYUNYUK. There was no difference in moisture and crude protein between the control group and the spice group. As for crude ash, the spice group was higher than the control group, and the crude fat was lower in the spice group compared to the control group. Table 3 shows the general ingredients of water, crude ash, crude protein, and crude fat of sirloin PYUNYUK. Moisture and crude ash had a higher spice group than the control group, and crude protein and crude fat had a lower spice group than the control group.

Table 2: Proximate composition of PYUNYUK shank (unit: %)

Sample	Control	Clove
Moisture	54.01±0.31	54.95±0.88
Crude ash	0.68±0.05	0.89±0.09
Crude protein	25.40±0.60	25.40±0.57
Crude fat	15.33±0.53	11.79±0.64

Table 3: Proximate composition of PYUNYUK loin (unit: %)

Sample	Control	Clove
Moisture	59.23±0.23	61.42±0.16
Crude ash	0.79±0.01	0.86±0.01
Crude protein	35.70±0.54	33.27±0.14
Crude fat	2.98±0.34	1.88±0.14

3.2. Mechanical properties

3.2.1. Chromaticity

3.2.1.1. Beef Jerky

The chromaticity of the refrigerated beef jerky is shown in Table 4. The brightness (L value) generally increased as the storage period increased in all jerky groups, and the rosemary-added group was higher than the control group and the clove-added group was lower. The redness (a value) increased in all jerky groups, and the rosemary-added group was the highest at -6.06 on the 28th of storage. The yellowness (b value) increased with the storage period, and the rosemary-added group was the highest at 2.71 on the 28th of storage. The increase in the value of all jerky groups due to the longer storage period is believed to be due to the decrease in moisture content according to the storage period. Table 5 is the result of chromaticity measurement stored at room temperature. The value of L increased with the storage period in all jerky groups, and the control group showed a slight increase, but the spice group increased significantly with the storage period than the control group. It was also higher than refrigerated storage. The value of a showed a gentle increase during the storage period in all jerky groups, and the rosemary and clove additives increased significantly from the 10th of storage. The b value increased in all jerky groups, and rosemary and clove additives were higher than in the control group. The fact that the L value stored at room temperature is higher than that of the refrigerated beef jerky group is due to the Maillard reaction, and the browning of low-water foods and organic products is due to the influence of external temperature, moisture content, and PH. It is judged to be the result of the increase in the L value due to the decrease in oxygen pressure and the formation of brown metmyoglobin due to the slow growth of microorganisms during storage due to dry meat tissue.

Table 4: Change of Hunter color values in beef jerky prepared with various spices during storage at 5°C

Hunter color value	Days	Sample		
		Control	Rosemary	Clove
L	0	21.43±1.17	21.57±0.72	20.27±0.08
	7	21.31±0.41	22.25±0.83	20.52±0.85

	14	21.75±0.13	22.34±0.42	20.72±0.46
	21	21.93±0.48	23.62±0.23	21.16±0.27
	28	22.48±0.31	23.57±1.01	21.61±0.19
	0	-8.30±0.09	-7.84±0.66	-7.93±0.39
	7	-6.59±0.23	-7.17±0.47	-7.82±0.63
a	14	-6.57±0.05	-7.34±0.33	-7.68±0.36
	21	-6.35±0.42	-6.19±0.35	-6.95±0.22
	28	-6.83±0.46	-6.06±0.45	-6.93±0.22
	0	-0.52±0.13	0.75±1.32	1.10±0.49
	7	0.33±0.16	0.86±0.06	1.44±0.12
b	14	0.08±0.16	1.36±0.12	1.66±0.61
	21	0.22±0.56	2.25±0.47	1.63±0.02
	28	0.97±0.01	2.71±0.28	2.23±0.37

Table 5: Change of Hunter color values in beef jerky prepared with various spices during storage at 25℃

Hunter color value	Days	Sample		
		Control	Rosemary	Clove
	0	21.43±1.17	21.57±0.18	20.27±0.08
	4	21.75±0.44	21.49±0.27	22.51±0.30
L	7	21.36±0.60	22.25±0.83	24.58±5.57
	10	21.98±0.51	29.36±3.47	26.57±0.04
	14	22.18±0.19	33.23±1.26	31.69±6.24
	0	-8.30±0.09	-7.84±0.66	-7.93±0.39
	4	-6.64±1.09	-7.37±0.41	-7.15±0.99
a	7	-6.60±0.27	-6.56±0.10	-7.60±0.18
	10	-6.38±0.49	-4.64±0.41	-3.51±0.15
	14	-6.47±0.32	-4.14±0.06	-3.54±0.25
	0	-0.52±0.13	0.75±0.02	1.10±0.06
	4	-0.27±0.07	0.72±0.005	0.91±0.02
b	7	0.02±0.01	0.65±0.10	1.40±0.15
	10	0.32±0.01	3.50±0.04	1.18±0.19
	14	1.44±0.04	5.25±2.15	3.85±0.07

3.2.1.2. PYUNYUK (traditional Korean dish, which consists of thinly sliced meat that has been boiled and pressed)

Table 6 shows the chromaticity measurement results of PYUNYUK. The L value of PYUNYUK was higher in the control group than in the spice group, and the value was higher in the spice group than in the control group. The value of b was lower in the spice group than in the control group.

Table 6: Hunter colour value of PYUNYUK loin

Sample	Control	Clove
L	60.23±0.46	35.95±0.14
a	3.42±0.03	6.95±0.03
b	11.43±0.01	7.75±0.04

3.2.2. Texture

3.2.2.1. Beef Jerky

Table 7 shows the results of measuring the texture of the refrigerated spice-added jerky. Hardness increased with the storage period in all jerky groups, and the rosemary-added group with high water content was lower than that of other jerky groups on the 28th after the storage period elapsed. Cohesiveness decreased over the storage period, and the spice group was higher than the control group. Springiness decreased with the storage period. On the day of manufacture, the control group was the lowest at 120.91, but the clove-added group was the lowest at 95.31 on the 28th depending on the storage period. Gumminess decreased in all jerky groups as the storage period elapsed, and was very low, especially on the 28th. Brittleness increased in all jerky groups as the water content decreased, and the spice group was higher than in the control group. Table 8 is a measurement of the texture of beef jerky stored at room temperature. Hardness decreased to 7 days of storage in all jerky groups, but increased over 10 days. The cohesiveness was higher in the spice group than in the control group, increased from the day of manufacture to the 10th, but decreased on the 14th of storage. The springiness increased from the day of manufacture to the 4th, but decreased after 10 days in the control group and 7 days in the spice group. On the day of manufacture, the clove-added group were the highest at 154.04, but on the 14th of storage, it was the lowest at 96. The gumminess increased with the storage period and then decreased on the 14th, and the spice group was higher than the control group. Brittleness gradually increased in all jerky groups, and rapidly increased in the control group and the rosemary group after 10 days of storage. On the day of manufacture, the control group was lower than the spice group, but it was the highest at 556.03 depending on the storage period, and the clove-added group was the lowest at 548.98. As a result of Texture measurement, aging is related to temperature, and protein is decomposed by spices added with various enzymes, peptide and amino acids are produced, and thus the taste of meat is soften and improved.

Table 7: Change of texture characteristics in beef jerky prepared with various spices during storage at 5℃

Texture	Days	Sample		
		Control	Rosemary	Clove
Hardness (Kg)	0	68365.6±30.95	73359.0±40.29	72749.1±29.13
	7	72754.9±33.66	75838.0±33.74	74143.7±36.00
	14	78261.7±33.98	78954.5±29.53	78256.9±37.64
	21	84740.2±28.72	83449.2±37.49	81550.2±33.89
	28	88463.1±30.44	86170.0±32.89	87356.1±28.31
Cohesiveness (%)	0	73.56±14.52	91.57±4.03	86.88±7.98
	7	67.18±12.06	88.29±9.28	68.92±2.75
	14	64.80±1.17	76.26±4.59	73.79±14,21
	21	61.75±5.41	73.73±3.68	72.65±5.46
	28	61.45±5.73	62.96±2.63	62.98±3.73
Springiness (%)	0	120.91±8.42	136.31±23.20	154.04±28.08
	7	102.79±16.23	129.02±8.23	129.11±6.28

	14	95.33±20.87	97.88±5.45	119.43±12.22
	21	95.96±7.44	103.60±3.37	108.73±5.85
	28	97.09±5.47	97.77±6.26	95.31±5.62
Gumminess (Kg)	0	498.76±154.41	534.50±29.99	546.09±18.19
	7	449.83±20.11	494.38±33.96	542.16±23.34
	14	375.55±17.35	451.93±30.57	527.83±19.34
	21	278.84±13.14	386.21±34.64	518.69±39.83
	28	274.90±33.31	355.12±40.61	355.12±40.61
Brittleness (Kg)	0	288.40±118.18	345.41±37.96	390.36±47.48
	7	239.64±21.32	500.14±73.95	441.48±40.18
	14	434.64±30.03	548.99±46.47	554.83±37.12
	21	443.04±42.61	649.28±29.76	541.98±32.50
	28	454.41±33.31	673.13±25.12	653.73±25.12

Table 8: Change of texture characteristics in beef jerky prepared with various spices during storage at 25℃

Texture	Days	Sample		
		Control	Rosemary	Clove
Hardness (Kg)	0	68365.6±30.95	73359.0±40.29	72749.1±29.13
	4	66457.9±15.96	65160.3±39.09	68253.1±32.82
	7	56036.7±33.88	57932.0±36.80	64635.6±35.15
	10	73966.9±26.03	72366.0±30.59	75249.5±32.04
	14	82558.3±23.98	82548.7±34.08	83747.3±26.98
Cohesiveness (%)	0	73.56±14.52	91.57±4.03	86.88±7.98
	4	87.24±3.43	84.50±2.82	100.23±3.59
	7	86.48±2.40	96.03±3.13	105.44±5.52
	10	91.09±4.92	100.53±1.67	107.43±9.03
	14	81.41±2.16	84.50±2.88	86.58±0.59
Springiness (%)	0	120.91±8.42	136.31±23.20	154.04±28.08
	4	130.89±11.70	151.56±18.52	160.87±11.36
	7	109.39±6.28	122.09±10.65	137.17±11.64
	10	111.51±4.00	113.20±9.42	134.85±4.59
	14	100.18±5.56	104.11±3.45	96.00±6.42
Gumminess (Kg)	0	498.76±154.41	534.50±29.99	546.09±18.19
	4	501.79±7.36	542.82±27.89	558.40±10.88

	7	506.87±8.54	568.28±25.81	575.86±23.44
	10	523.97±21.08	577.62±8.88	578.96±25.24
	14	331.25±11.83	469.05±30.16	422.47±17.69
Brittleness (Kg)	0	288.40±118.18	345.41±37.96	390.36±47.48
	4	313.23±23.62	366.69±30.15	407.84±15.13
	7	352.34±37.32	406.29±14.69	442.51±22.81
	10	458.27±19.44	500.14±73.95	448.93±30.17
	14	556.03±25.82	550.15±39.62	548.98±15.78

3.2.2.2. PYUNYUK

Table 9 shows the results of measuring with rheometer to find out the texture of the PYUNYUK with additional ingredients. Hardness was found to have a lower spice group than the control group, improving softness, and cohesiveness and gumminess showed no difference between the control group and the spice group. It was found that the spices used in this experiment have a good effect on softening the meat quality.

Table 9: Mechanical characteristics of PYUNYUK loin

Mechanical properties	Control	Clove
Hardness (Kg)	0.23±0.06	0.13±0.02
Cohesiveness (%)	61.50±1.52	62.69±2.53
Springiness (%)	77.05±2.22	74.04±2.43
Gumminess (Kg)	0.56±0.13	0.50±0.11
Brittleness (Kg)	0.43±0.10	0.37±0.08

3.3. Physicochemical properties

3.3.1. Thiobarbituric acid reactive substances (TBARS)

3.3.1.1. YUKWONJEON (Traditional Korean dish, cooked with finely chopped beef, mixed with tofu, and then grilled with various seasonings)

Thiobarbituric acid reactive substances (TBARS) experiments for measuring lipid acidification were measured on the day of manufacture, refrigerated storage on the 3rd and 7th days, and frozen storage on the 15th and 30th days. Table 10 and 11 show the changes in the amount of malonaldehyde (MDA) mg/kg during the refrigeration and frozen storage period of Yukwonjeon. According to TBARS experiment results of the Yukwonjeon during refrigerated storage, the control group at the day of manufacture was measured at 0.64 MDA mg/kg, and the rosemary 0.5% group was measured at 0.51 MDA mg/kg. The control group tended to have a slightly higher TBARS value, that is, lipid rancidity, than the spice group, but there was no significant difference. On the other hand, when stored on the 3rd and 7th days of refrigerated storage, the spice group showed a difference from the control group and the lipid rancidity was measured to be low. There was no difference in MDA production between the control group and the spice group in the Yukwonjeon 15 days after frozen storage, but the spice group tended to show somewhat less fatty oxidation as on the day of manufacture. However, in the 30 days of frozen storage, the spice group showed a difference compared to the control group, and the amount of MDA production was suppressed. Compared to the control group, MDA production was suppressed by about 27% in the rosemary-added group.

Table 10: TBA value of Beef-Yukwonjeon (MDAmg/kg) after storage at 6℃

Sample	Storage days		
	0	3	7
Control	0.64±0.08	1.71±0.03	1.64±0.01
Rosemary 0.5%	0.51±0.01	0.80±0.02	1.29±0.04

Table 11: TBA value of Beef-Yukwonjeon(MDAmg/kg) after storage at -20℃

Sample	Storage days		
	0	15	30
Control	0.64±0.08	1.08±0.03	1.55±0.00
Rosemary 0.5%	0.51±0.01	0.94±0.04	1.13±0.01

3.3.2. PH

3.3.2.1. Beef Jerky

Table 12 shows the pH of the beef jerky stored at refrigerated and room temperature. The pH of the refrigerated beef jerky decreased according to the storage period in all jerky groups, and the spice group was lower than the control group. The control group was significantly lowered on the 14th, and the rosemary-added group increased on the 14th and then decreased again. The clove-added group was slightly lower than other jerky groups during the storage period. The pH of the spice group stored at room temperature was relatively lower than that of the control group, and in all jerky groups, it gradually decreased at the beginning of storage and then decreased sharply over time.

Table 12: Change of Ph values in beef jerky prepared with various spices during storage at 5℃ and 25℃

Temperature	Days	Sample		
		Control	Rosemary	Clove
5℃	0	5.75±0.10	5.68±0.03	5.70±0.05
	7	5.70±0.02	5.65±0.05	5.61±0.03
	14	5.64±0.04	5.67±0.02	5.59±0.08
	21	5.62±0.04	5.64±0.04	5.59±0.02
	28	5.65±0.05	5.63±0.04	5.41±0.01
25℃	0	5.75±0.10	5.68±0.03	5.70±0.05
	4	5.74±0.04	5.75±0.10	5.69±0.09
	7	5.66±0.03	5.65±0.02	5.62±0.03
	10	5.46±0.06	5.45±0.04	5.57±0.07
	14	5.43±0.03	5.42±0.02	5.42±0.01

3.3.3. Sensory test

3.3.3.1. Beef Jerky

Table 13 shows the sensory test results of the beef jerky stored in the refrigerator. In terms of color, the spice group was higher than the control group during the storage period, and the clove-added group was the highest. It was high on the 7th of

storage in all jerky group and lowered from the 14th. Taste was the highest in the rosemary-added group among the spice groups and the clove-added group was the lowest. Flavor increased with the storage period in all jerky groups. In Overall quality, the control group was the highest on the day of manufacture, and the clove-added group was the lowest, but gradually increased, showing the highest value of 4.37 on the 14th of storage. Table 14 shows the sensory test results of beef jerky stored at room temperature. The color of the control group increased with the storage period, but the spice group decreased, and the clove-added group was higher than that of other jerky groups. The flavor increased with the storage period in all jerky groups. In terms of taste, the control group slightly increased compared to the day of manufacture, the spice group decreased compared to the day of manufacture, and the clove-added group was the lowest. In overall quality, the clove-added group was low. The difference in preference according to the storage period was small, but the preference of the control group was the highest at 4.62 on the 4th day of storage. In overall quality, the control group was the highest at 3.87 on the day of manufacture, and the control group and rosemary-added group increased with the storage period. The clove-added group decreased with the storage period, and showed the lowest preference at 2.50. Compared to the room temperature storage beef jerky, the refrigerated storage beef jerky showed a higher preference, and it is judged that the refrigerating method is more desirable for storing processed meat products.

Table 13: Change of sensory properties in beef jerky prepared with various spices during storage at 5℃

Sensory	Days	Sample		
		Control	Rosemary	Clove
Color	0	3.50±1.60	5.00±1.06	5.75±0.88
	7	4.00±1.51	5.00±1.51	6.00±0.75
	14	2.75±1.16	4.37±1.18	4.75±1.66
	21	2.75±1.66	3.75±1.98	4.75±1.58
	28	2.12±0.99	2.87±1.80	4.12±1.24
Flavor	0	3.50±1.85	4.50±1.41	2.87±1.88
	4	3.75±1.66	4.50±1.69	3.00±2.13
	7	3.75±1.28	4.50±1.03	3.00±1.69
	10	3.87±1.24	4.75±1.03	3.62±1.84
	14	4.87±0.99	4.75±1.28	3.87±1.64
Taste	0	4.25±1.66	3.62±1.50	3.12±0.64
	7	4.00±1.85	3.75±1.48	3.62±1.99
	14	3.62±1.76	4.25±1.48	3.12±0.99
	21	4.37±1.84	4.62±1.50	3.62±1.68
	28	4.50±1.77	4.12±1.95	3.75±1.98
Overall quality	0	3.87±1.45	3.25±1.28	2.75±1.58
	4	4.37±1.68	3.62±1.30	2.75±0.88
	7	3.50±1.60	4.00±1.03	3.75±1.38
	10	4.62±1.59	4.00±1.85	3.25±1.38
	14	3.75±1.28	4.00±1.92	4.37±1.99

Table 14: Change of sensory properties in beef jerky prepared with various spices during storage at 25℃

Sensory	Days	Sample		
		Control	Rosemary	Clove
Color	0	3.50±1.60	5.00±1.06	5.75±0.88
	7	3.50±2.00	5.00±1.51	5.67±0.75
	14	3.87±1.80	4.00±1.60	5.50±1.19
	21	4.50±1.06	4.00±1.30	5.00±1.75
	28	4.50±2.20	3.25±0.70	4.25±1.06
Flavor	0	3.50±1.85	4.50±1.41	2.87±1.88
	4	4.00±1.19	4.62±1.59	3.00±2.13
	7	4.12±1.12	4.80±0.75	3.50±2.26
	10	4.87±1.72	4.92±1.59	3.75±1.75
	14	5.00±1.85	4.95±1.83	4.37±1.19
Taste	0	4.25±1.66	3.62±1.50	3.12±0.64
	7	4.00±1.85	3.75±1.48	3.62±1.99
	14	4.92±1.28	3.62±1.30	3.75±1.03
	21	4.50±1.30	3.75±1.83	3.00±1.19
	28	4.37±1.92	3.50±1.51	2.62±1.06
Overall quality	0	3.87±1.45	3.25±1.28	2.75±1.58
	4	4.62±1.68	3.87±1.30	2.37±0.88
	7	4.37±1.18	3.62±1.59	2.87±1.12
	10	4.37±1.68	3.87±1.12	2.75±0.88
	14	4.12±0.99	3.62±1.84	2.50±0.53

3.3.3.2. PYUNYUK

The sensory test results of PYUNYUK are shown in Table 15. As for the color, the cinnamon-added group was the highest at 5.10, and the control group was the lowest. This seems to appear higher as the unique color of the spice and the addition of additional ingredients increase. The aroma and taste were high in the clove-added group and lowest in the control group. In overall quality, the clove-added group was higher than the control group, soy sauce, onion, and cinnamon additive group. Overall, the clove-added group had the highest preference in all items except color. It is interpreted as a desirable result that the spice groups used in this experiment have high preference for PYUNYUK to which they are added along with antioxidant and nitrite elimination, and it is determined that many studies should be conducted on the proper use of these materials.

Table 15: Sensory characteristics of PYUNYUK shank

Sensory properties	Control	Soy sauce	Onion	Cinnamon	Clove
Color	4.05±1.4	4.15±1.5	4.40±1.0	5.10±1.16	4.40±1.6

	7	0	9		0
Flavor	3.15±1.53	4.50±1.23	4.10±1.37	4.85±1.63	5.25±1.55
Taste	3.30±1.08	4.00±1.08	4.20±1.06	4.95±0.99	5.20±1.10
Overall	3.45±1.14	4.40±1.31	4.55±1.28	4.60±1.43	5.70±1.03

4. Conclusion

This study investigated how rosemary and clove spices affect general ingredients, mechanical properties, physicochemical properties, and sensory tests for meat products using beef and pork processed products. In the analysis of the general ingredients of beef jerky, the moisture and inquiry were found to be high in the rosemary-added group, the crude fat was the highest in the clove-added group, and the crude protein was the lowest in the clove-added group. The spice group used in this study had a slightly higher crude protein content than the commercially available beef jerky. In the analysis of the general ingredients of shank PYUNYUK, there was no difference in moisture and crude protein between the control group and the spice group, but crude ash had a higher spice group than the control group, and crude fat had a lower spice group than the control group. The moisture and crude ash of sirloin PYUNYUK were high in the spice group, and crude protein and crude fat were low in the spice group. In the chromaticity of mechanical properties, the L value, the value, and the b value of the refrigerated storage beef jerky all increased on the 28th day of storage compared to the day of manufacture. During room temperature storage, the L value, the value, and the b value all increased on the 14th day of storage compared to the day of manufacture and were higher than that of refrigerated storage. The fact that the room temperature storage L value is higher than that of the refrigerated beef jerky group is due to the Maillard reaction, which is considered to be the result of the formation and increase of brown metmyoglobin. The L and b values of PYUNYUK were lower in the spice group than in the control group, and the value was higher in the spice group than in the control group.

In Texture, the hardness and brittleness of beef jerky during refrigerated storage (5°C) increased overall in all jerky groups. In addition, springiness and gumminess overall decreased in all jerky groups according to the storage period. The brittleness and springiness were generally higher in the spice group than in the control group. The hardness of room temperature storage (25°C) decreased and then increased. In cohesiveness, springiness, and gumminess, the spice group decreased on the 14th of storage compared to the day of manufacture. The brittleness increased in all jerky groups. These results are due to aging of meat, and aging is related to temperature, and it is judged that protein decomposition and peptide and amino acids are produced by spices added with various enzymes, making the taste of meat soft and better. The hardness of beef jerky was lower in the spice group than in the control group, indicating that there was an effect of improving softness, and cohesion and gumminess did not show a significant difference between the control group and the spice group. In other words, the effect of spices on the texture of meat increased both brittleness when storing at 5°C and 25°C, and in PYUNYUK, the hardness was measured lower than that of the control group, indicating an effect of improving softness.

In terms of physiochemical characteristics, TBARS of the Yukwonjeon showed differences in the spice group from 3 days after refrigerated storage, and the lipid rancidity was measured low compared to the control group. There was no difference in MDA production between the control group and the spice group after 15 days of frozen storage, but in 30 days of frozen storage, the spice group showed differences compared to the control group, and the MDA production was suppressed. In particular, MDA production was suppressed by about 27% in the rosemary-added group. The pH of beef jerky stored at room temperature and refrigerated decreased according to the storage period, and the spice group was lower than the control group. In the case of beef jerky in the sensory test, the color of the refrigerated storage was high on the 7th of storage in all jerky groups and decreased from the 14th. The flavor increased with the storage period, and the rosemary-added group was the highest. In terms of taste and overall quality, the control group was the highest on the day of manufacture, and the clove-added group was the lowest, but gradually increased, the highest on the 14th of storage. The color of the spice group stored at room temperature increased with the storage period, but the spice group decreased, and the clove-added group was the highest. The flavor increased with the storage period in all jerky groups. The taste of rosemary-added group increased until the 7th day of storage, and the clove-added group increased until the 14th and then decreased. As for the overall quality, the clove-added group was the lowest. Compared to the room temperature storage beef jerky, the refrigerated storage beef jerky showed a higher preference, and it is judged that the refrigeration method is more desirable for storing processed meat products. In terms of aroma, taste, and preference, excluding the color of PYUNYUK, the clove-added group was the

highest. Overall, the spice group was higher than the control group, and the clove-added group showed high preference in all items. Therefore, it shows that the addition of spices improves storage by selecting and adding natural spices suitable for raw meat instead of artificial antioxidants that are harmful to the human body, and suppresses fat peroxide after storage, as well as reducing rancid flavor and maintaining sensual quality. In addition, the low content of crude fat in the general ingredient of PYUNYUK is believed to be possible to develop a meat processing product that can satisfy consumers' desire for low-fat, low-calorie products, which is considered to be basic data for the production of health-oriented specialized meat processing products that can be accepted by the public.

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