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(71) Applicant(s)
The Industry & Academic Cooperation in Chungnam National University

(72) Inventor(s)
Jo, Cheor un;Kruk, Zbigniew A.;Yun, Hey jung;Rutley, David

(74) Agent / Attorney
Shelston IP, Level 21 60 Margaret Street, Sydney, NSW, 2000

(56) Related Art
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ABSTRACT

The present invention relates to a method of producing high quality non-comminuted meat products comprising adding to the non-comminuted meat at least one selected ingredient from the group consisting of vegetable or animal oil or fat and seasoning sauce, vacuum packaging and processing the product under high hydrostatic pressure.

According to the present invention, the high quality non-comminuted meat products are characterized not only by the increased consumer sensory preference and willingness to purchase but also by improved safety, storage stability, physicochemical properties, and in general, provide healthier meat products.

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Name of Applicant: The Industry & Academic Cooperation in Chungnam National University

Actual Inventors: Cheor un Jo and Zbigniew A. Kruk and Hey jung Yun and David Rutley

Address for Service is:

SHELSTON IP
60 Margaret Street
SYDNEY NSW 2000
CCN: 3710000352
Attorney Code: SW

Telephone No: (02) 9777 1111
Facsimile No. (02) 9241 4666

Invention Title: METHOD FOR PRODUCING HIGH QUALITY NON-COMMINUTED MEAT PRODUCTS USING HIGH HYDROSTATIC PRESSURE TECHNOLOGY AND PROCESSED MEAT GOODS

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

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SPECIFICATION

METHOD FOR PRODUCING HIGH QUALITY NON-COMMINUTED MEAT PRODUCTS USING HIGH HYDROSTATIC PRESSURE TECHNOLOGY AND PROCESSED MEAT GOODS

TECHNICAL FIELD

The present invention relates to a method of producing high quality non-comminuted meat products comprising of the following steps: (1) addition of at least one component selected from the group consisting of vegetable or animal oils and fats, and/or seasoning sauce to non-comminuted meat, (2) carrying out vacuum packaging and (3) processing the product under high hydrostatic pressure.

BACKGROUND ART

A rapid industrial development in many countries has been accompanied by the increased income of many consumers which consequently has impacted the life style and food consumption. Many people tend to dine out and look for food of superior quality. Meat consumption in these countries has risen and consumers have changed their preferences demanding high quality products, that are tender, have desirable flavor, safe and consistent quality.

Recently, the preference for poultry meat has increased as poultry meat is perceived as low fat, low cholesterol, low calorie and high protein. In particular, poultry meat has a soft, unique taste and flavor, and is therefore widely appreciated. Also chicken meat consumption has increased due to recent development of new products created by various processing technologies that improve its quality. Furthermore, in order to improve both the quantity and quality of poultry meat demanded, efforts have been undertaken to manufacture products that posses distinct qualities. For example, addition of docosahexanoic acid (DHA), germanium and selenium, etc. and hygienically improved processing techniques are the primary

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applications. A number of studies have now been carried out implementing pharmaceutical components that have specific health benefits or utilizing natural products that improve the quality of meat. These new products are characterized by improved texture, taste and the ability to prevent various diseases. The new products improve the competitiveness of meat against other foods and significantly benefit livestock producers. However, product development is tiresome, costly, and requires a long time to prove the benefits of the treatment.

Marbling indicates distribution of fat, which makes meat tender and juicier. Marbling corresponds to a small piece or a thin layer of fat within the muscle tissues, providing enriched eating experiences (flavor, tenderness and juiciness). For that reason, marbling is the major criterion in meat grading systems. Small and evenly distributed marbling flecks within the matrix of muscle and connective tissue break its structure and produce more preferable meat.

Meat is a nutrient-dense food. During meat production and distribution, the chance of microbial contamination is high. Once meat is contaminated the likelihood of a food borne disease outbreak becomes high. In spite of stringent food safety systems and the application of various technologies for processing and packaging meat to reduce spoilage and improve meat safety, there are still many incidences of illness caused by bacterial contamination of meat.

Generally, there are two methods to pasteurize food products, thermal and non-thermal methods. Thermal pasteurization effectively inhibits microbial growth so the storage period can be extended. However, the thermal treatment can change the unique quality and functional properties of the treated food and adversely affected the overall quality. When meat is thermally pasteurized, the color, flavor and texture of the meat may be affected. To overcome these disadvantages, non-thermal pasteurization methods have been developed including electromagnetic wave, pulsed electric field, infrared or UV ray, irradiation, ultra high pressure, natural antimicrobial

agents, antimicrobial enzymes, etc. Among them food irradiation technology has been developed for improving food safety. Irradiation can be used for foods in finished packaging to prevent cross contamination. Heat treatment cannot be used in this situation. However, this technology has not been widely commercialized yet, due to requirements for installation of specific facilities, the need for highly trained staff and low consumer acceptance.

Alternatively, high hydrostatic pressure (HHP) causes minimal changes to flavor and taste and can be applied to the product in a packaged state. HHP has been employed to improve the safety of rice, ham, milk, orange juice, and seafood products. Furthermore, consumer acceptance of HHP is good. However, studies on HHP have been limited to theoretical testing and microbial inactivation. Thus, if HHP is applied thereto, more advanced techniques should be developed aimed to improve function and quality of products.

Korean Patent Registration No. 0770692 disclosed a method of enhancing storage stability of oysters based on high hydrostatic pressure processing. However, it is different from the method for producing high quality non-comminuted meat product using high hydrostatic pressure technology of the present invention.

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

DETAILED DESCRIPTION OF THE INVENTION, PROBLEMS TO BE SOLVED BY THE INVENTION

The present invention was devised in response to the needs described above. According to the present invention, non-comminuted meat was used and at least one ingredient selected from the group of vegetable or animal oil or fat and seasoning sauce

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was added, then samples were vacuum packaged and processed under high hydrostatic pressure. The addition of oil or fat, increased the levels of unsaturated fatty acids when compared with original meat. Therefore, the HHP processed meat becomes favorable. Furthermore, the addition of vegetable or animal oil or fat provides the meat with a marbling effect making the meat more tender and juicy so that it is preferred by consumers.

The high hydrostatic pressure technology can solve the problems of conventional meat pasteurization processes which can minimize the quality changes during processing such as color, flavor and texture. The HHP method described can be useful for quick insertion of oil, fat and seasonings into meat. As a result, high quality non-comminuted meat products can be manufactured within short processing time and improved safety, storage stability, physicochemical properties, and healthier for human consumption. Consequently, the present invention was completed.

MEANS FOR SOLVING THE PROBLEMS

To solve the problems described above, the present invention provides a method of producing high quality non-comminuted meat products comprising the addition to non-comminuted meat of at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce, carrying out vacuum packaging and processing the product under high hydrostatic pressure.

EFFECT OF THE INVENTION

According to the present invention, to non-comminuted meat, at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce is added, and the product is vacuum packaged and processed under high hydrostatic pressure to produce a high meat product. Specifically, by adding vegetable or animal oil or fat to common non-comminuted meat or a low grade meat with less marbling, increases the unsaturation level of fatty acids as compared to animal

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fat, and therefore, the meat becomes more preferable. In addition, by adding vegetable or animal oil or fat, creates a marbling effect in the meat, thus further increasing consumer preference.

Other meat pasteurization methods reduce the non-comminuted meat quality by adversely affecting color, flavor and texture. High hydrostatic pressure can minimize such changes. Marination of meat usually requires the meat to be immersed in a seasoning solution (i.e., curing solution) for several hours. Using the high hydrostatic pressure processing of the present invention, vegetable or animal oil or fat, and seasonings can penetrate into the meat quickly, in several minutes. As a result, the processing time can be greatly reduced. Using the method of the present invention non-comminuted meat products with enhanced safety and storage stability, improved physicochemical properties, and significant economic advantages can be obtained.

MODE FOR CARRYING OUT THE INVENTION

According to a first aspect, the present invention provides a method of producing high quality non-comminuted meat products comprising adding at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce to non-comminuted meat, vacuum packaging and processing the product under high hydrostatic pressure.

According to a second aspect, the present invention provides a high quality non-comminuted meat products that are produced according to the method described in the first aspect.

Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising", and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

In order to achieve a preferred objective of the present invention, the present invention provides a method of producing high quality non-comminuted meat products

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comprising adding to highly consumed non-comminuted meat, instead of comminuted meat, at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce, carrying out vacuum packaging and processing the product under high hydrostatic pressure.

The non-comminuted meat described above can be any meat such as pork, beef, sheep meat, chicken meat, goat meat, duck meat, turkey meat, horse meat, dog meat, kangaroo meat and fish but not limited thereto.

According to the method for producing high quality non-comminuted meat products of the present invention, the material which is applied to non-comminuted meat can be at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce. The vegetable oil can be any vegetable oil, including but not limited to olive oil, grape seed oil, linseed oil, canola oil, castor oil, evening primrose oil, soybean oil, tung oil, hashish oil, rapeseed oil or palm oil. The animal fat can be any animal fat, including but not limited to tallow, lard and chicken fat.

The seasoning sauce can be any seasoning sauce, which may contain ingredients including but not limited to soy sauce, hot pepper paste, red pepper powder, salted sesame, sugar, syrup extract of whole pepper, onion extract, garlic extract, ginger, scallion, purified salt and the like.

The high hydrostatic pressure processing according to the present invention can be a 2 to 25 minute processing at 250 to 650 MPa.

With respect to the method for producing the high quality non-comminuted meat products of the present invention marbling (distribution of fat in meat) is improved specifically, by adding vegetable or animal oil or fat to meat, this improves both intramuscular fat percentage and marbling.

The method for producing the high quality non-comminuted meat products of the present invention may comprise,

- cutting and separating non-comminuted meat into pieces of 10 to 250 g;

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- adding at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce to the non-comminuted meat in an amount of 0 to 15% (w/w) on the basis of the weight of the meat, vacuum packaging all ingredients, and:

- processing the vacuum packaged non-comminuted meat under high hydrostatic pressure of 250 to 650 MPa for 2 to 25 minutes.

More preferably, it may comprise,

- cutting and separating non-comminuted meat into pieces of 100 g;

- adding at least one ingredient selected from the group consisting of olive oil and soy sauce to the non-comminuted meat in an amount of 10% (w/w) on the basis of the weight of the non-comminuted meat, and carrying out vacuum packaging the meat; and

- processing the vacuum packaged non-comminuted meat under high hydrostatic pressure of 300 MPa for 5 minutes at room temperature.

In the method for producing the high quality non-comminuted meat products of the present invention, the non-comminuted meat may be preferably chicken breast meat.

As such, the method for producing the high quality chicken breast meat products of the present invention may preferably comprise,

- cutting and separating chicken breast meat into pieces of 15 to 150 g;

- adding at least one ingredient selected from the group consisting of olive oil and soy sauce to the chicken breast meat in an amount of 5 to 15% (w/w) on the basis of the weight of the non-comminuted meat, and carrying out vacuum packaging the meat; and

- processing the vacuum packaged chicken breast meat under high hydrostatic pressure of 250 to 650 MPa for 2 to 8 minutes at room temperature.

More preferably, it may comprise,

- cutting and separating chicken breast meat into pieces of 100 g;

- adding at least one ingredient selected from the group consisting of olive oil and soy sauce to the chicken breast meat in an amount of 10% (w/w) on the basis of the weight

of the chicken breast, and carrying out vacuum packaging the meat; and

- processing the vacuum packaged chicken breast meat under high hydrostatic pressure of 300 MPa for 5 minutes at room temperature.

Further, the present invention provides high quality non-comminuted meat products that are obtained by the method described above. Regarding the high quality non-comminuted meat product of the present invention, as vegetable or animal oil or fat is added to common non-comminuted meat, the marbling effect is given to meat, thus the meat product becomes more tender and juicy and preferred by consumers. Further, by adding vegetable oil which has higher levels of unsaturated fatty acids compared to animal fat, high quality non-comminuted meat product that is more beneficial in terms of human health can be produced.

Still further, by using high hydrostatic pressure technology, the vegetable or animal oil or fat and seasoning sauce can quickly penetrate into the meat, reducing the processing time to several minutes, and due to control of microorganisms by high pressure processing, a pasteurized meat product having enhanced storage stability and improved physicochemical properties can be produced.

Herein below, the present invention is explained in greater detail in view of the Examples. However, the following Examples are only to exemplify the present invention and the present invention is not limited by the Examples.

Materials and Method for Experiment

1. Materials for Experiment

Chicken breast meat (Orpum Co. Ltd., Sangju, Korea), soy sauce (Sampio Co. LTd., Seoul, Korea), and olive oil (Sajo Co. Ltd., Incheon, Korea) were purchased from a local market located in Daejon, South Korea.

2. Method for Experiment

(1) Method of producing chicken breast meat product

Chicken breast meat was cut into pieces of about 100 g and 10% (w/w) of soy sauce, 10% (w/w) of olive oil, and a mixture comprising 5% (w/w) of soy sauce and 5% (w/w) of olive oil were added, respectively, based on the weight of the chicken breast meat. The all ingredients were vacuum packaged in a polyethylene bag. The high hydrostatic processing was carried out under 300 and 600 MPa for 5 minutes. The samples were stored at 4℃ for 14 days and used for physicochemical analyses. As a control group, meat which had not been treated with soy sauce, olive oil or the high hydrostatic pressure processing was used. In addition, a sample to which 300 MPa pressure had been applied without any olive oil or soy sauce and the other sample to which olive oil (10%) had been added followed by application of high hydrostatic pressure of 600 MPa were prepared. They were later examined along with the control group for sensory test and analysis of fatty acid composition.

(2) Proximate composition and physicochemical characteristics

Proximate composition of the sample was carried out according to AOAC (1995) method. Specifically, moisture content was determined by heating or drying samples for 15 hours at 102℃ according to a dry oven method and measuring the amount of evaporated moisture. Crude fat content was measured according to Soxhlet method. Cooking loss was obtained by cutting muscle tissues with a steak-shape piece having 2.5 cm thickness, heating it in a hot water bath at 80℃ until the internal temperature reached to 70℃. The percentage ratio of weight difference before and after the heating was considered as cooking loss. pH measurement was carried out by adding 90 ml of distilled water to 10 g sample, homogenizing the mixture for 1 minute at 1,130 × g by using a homogenizer (T25 basic, Ika Co., Staufen, Germany). pH was measured using a pH meter (750P, Istek Co., Seoul, Korea). The results are the average value obtained from three separate measurements.

(3)Surface color

Surface color was measured by using a spectrophotometer (CM-3500d, Minolta, Tokyo, Japan). Specifically, the sample was prepared in the size of 4 cm diameter and 1.5 cm thickness and repeatedly measured for three times using a large size aperture. The average value was expressed as L^*(brightness), a^*(red color) and b^*(yellow color) on the Hunter color scale. The measured value was automatically analyzed by Spectra Magic Software (Minolta, Tokyo, Japan).

(4)Texture

Texture was measured by cutting each sample into pieces having same size (diameter 30 mm, height 20 mm) using a A-XT2 texture analyzer (Stable Microsystems, Surrey, UK). Needle with the diameter of 75 mm was used, the measurement speed was 1.00 mm/sec and the trigger force was 0.005 kg.

(5)Lipid peroxidation (2-thiobarbituric acid reactive substances, TBARS)

For measuring lipid peroxidation, 3 g sample was collected, added with 12 mL distilled water and homogenized according to the method by Ahn et. al (1999). The homogenized mixture (5 mL) was transferred to a test tube and added with 5 mL TBA/TCA solution (20 mM thibarbituric acid in 15% trichloroacetic acid) with 50 μL 7.2% BHA solution. The mixture was heated in a water bath for 15 min at 90°C. After cooling with tap water, the mixture was centrifuged (3,000 rpm) for 15 minutes. Absorbance of the supernatant obtained after the centrifugation was determined by spectrophotometer (UV 1600 PC, Shimadzu, Tokyo, Japan) at 532 nm. Lipid peroxidation level was expressed in mg malondialdehyde/kg meat.

(6)Volatile basic nitrogen (VBN)

VBN content was determined according to the method of Conway (1950). To 10 g of the sample, 30 mL of distilled water was added, homogenized for 5 minutes at 14,000 rpm by using a homogenizer (NS-50, Japan). The homogenate was

filtered through a filter paper (Whatman No.1) and then adjusted to total volume of 100 mL. The filtrate (5 mL) was placed in an outer chamber of the Conway unit while 0.01 M boric acid solution (5 mL) and two to three drops of the Conway reagent (0.066% methyl red + 0.066% bromocresol green, in 1:1 ratio) respectively prepared by using ethanol were added to the inner chamber. After quickly adding 5 mL of 50% K_2CO_3 solution to the outer chamber, the cover of Conway unit was closed, and then kept at 37℃ for 120 min. Consequently, the boric acid solution present in the inner chamber was titrated with 0.02 M H_2SO_4 solution.

(7) Fatty acid composition

To determine the fatty acid composition, lipids were extracted from each sample according to the method described by Folch et al. (1957). The meat sample (30 g) was mixed with 150 mL Folch solvent (methanol: chloroform = 1:2). KOH 0.88% was added to this solution and the samples were incubated at room temperature for 2 h. The upper layer was removed, after which the lower chloroform was dehydrated and filtered with Na_2SO_4. After removing the solvent from the filtered solution, the total lipids were methylated by adding BF_3-methanol (Sigma-Aldrich Co., St Louis, Mo, USA) at 90℃ for 1 hr. After cooling the samples, 1 mL of methylating reagent (BF_3-methanol, Sigma Chemical Co.) was added to 100 μL of the lipid sample and heated at 70℃ for 30 min. The samples were removed from the water bath, allowed to cool, and 2 mL of hexane (HPLC grade) and 5 mL of distilled water were added. The samples were vortexed and the upper layer removed. The fatty acid methyl ester dissolved in hexane was transferred to a GC vial and the fatty acid composition was analyzed using a GC (6890, Agilent Technologies, Inc., Santa Clara, CA, USA) equipped with a capillary column (30 m x 0.32 mm x 0.25 μm film thickness, Omegawax 320, Supelco Inc., Bellefonte, PA, USA) and a flame ionization detector. During analysis, the temperatures of the oven, inlet and detector were 200, 250 and 260℃, respectively. N_2 (99.999%) was applied as a carrier gas at a linear flow of 0.79 mL/min and a split ratio of 100:1. Fatty acids were identified by comparison of the

retention times to known standards. The relative quantities were expressed as the weight percent of total fatty acids.

(8) Microbial analysis

The microbial strains used for the present test were *Listeria monocytogenes* (KCTC 3569), *Salmonella typhimurium* (KCTC 1925), and *Escherichia coli* (KCTC 1682). Each strain was primarily cultured at 25℃ for 24 hours using tryptic soy broth (Difco, Laboratories, Detroit, MI, USA). After centrifuging the culture solution at 3,000 rpm for 10 minutes, the cells were washed twice with 0.85% NaCl to obtain the final concentration of approximately 10^8 CFU/mL. Homogeneous upper solution was taken (0.1 mL) and inoculated to the surface of sample, which was then packaged in a polyethylene bag. After the sealing, the bag was kept at 4℃.

(9) Inactivation of pathogens

Microbial testing of samples was carried out by adding sterile saline (90 mL, 0.85% NaCl) to the sample (10 g), mixing for 120 seconds using Bag mixer® (Model 400, Interscience, France), and diluting the mixture based on 10-fold serial dilution. Each diluent (100 mL) was inoculated to tryptic soy agar (Difco, Laboratories, Detroit, MI, USA), and cultured for 72 hrs at 37℃. The number of colonies produced was counted and expressed as colony forming unit per 1 g (CFU/g).

(10) Sensory test

Chicken breast meat was cut to have the same size, cooked until the internal temperature reached 75℃ and the sensory quality of the sample was determined. With respect to tenderness, to see any variations between people of different ages, the sensory test was performed for two separate groups, (1) a college student group consisting of 19 to 29 year old students and (2) a housewife group consisting of 40

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to 50 year old housewives. Sensory/quality parameters tested included color, flavor, tenderness, juiciness, chewiness, flavor, overall acceptance, and willingness to buy.

(11) Statistical analysis

Each test was repeated for three times independently. The data were analyzed using a general linear model procedure (PROC GLM; SAS, 1989). When there was a significant difference found, the difference among the mean values was analyzed using Duncan's Multiple Range Test.

SAS. 1989. *SAS/STAT User's Guide*. Version 6, 4th ed., Vol. 2. Cary, N.C.: SAS Institute, Inc.

Example 1: Proximate composition of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Table 1 shows the results of the proximate composition of the chicken breast meat with added with soy sauce (10%), olive oil (10%), or a mixture of soy sauce (5%) and olive oil (5%) and subjected to 300 MPa high hydrostatic pressure processing. It was found that the moisture content was significantly higher in the sample added with olive oil (10%) when compared with the control. In particular, cooking loss, which is an important factor in quality and taste of cooked product, was significantly smaller compared to the control group, indicating that it is favorable in terms of cooking and processability. Fat content was significantly higher in the sample added with olive oil. This result indicates that the olive oil (10%), which had been added to chicken breast meat, successfully penetrated into the inside of the meat by high hydrostatic pressure processing. As a result, the total fat content of treated sample increased compared to the control group.

[Table 1]

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General components of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Treatment group	Moisture content (%)	Cooking loss (%)	Fat content (%)
Control group	70.28ab	31.62b	1.51c
Soy sauce (10%)/300 MPa	66.93b	33.73ab	6.27ab
Olive oil (10%)/300 MPa	72.04a	28.71c	5.06b
Soy sauce (5%)+olive oil (5%)/300 MPa	66.78b	35.91a	6.87a
Standard error	1.264	0.868	0.492

a-c: different letters in the same column indicate a significant difference ($P<0.05$).

Example 2: Fatty acid composition of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Fatty acid composition of the chicken breast meat was analyzed and shown in Table 2. The sample with added soy sauce (10%), olive oil (10%), or a mixture (1:1) of soy sauce and olive oil (10%), not treated with high hydrostatic pressure showed no difference compared to the control group in terms of the content of oleic acid, the main component of olive oil. However, processed under 300 MPa pressure the sample showed significantly higher content compared to the control. When 10% olive oil was added and processed under 600 MPa pressure, oleic acid content increased by 5.75% compared to the control group. Thus it was found that, high hydrostatic pressure processing under 300 MPa pressure or more, caused olive oil to penetrate into the chicken meat producing high oleic acid content in the product. It was further found that, the penetration of oil into chicken breast meat also has an effect of increasing moisture retention in the product. Compared to the control group, the level of unsaturated fatty acids appeared to be significantly higher in the chicken breast meat with added olive oil or a mixture of olive oil and soy sauce followed by high hydrostatic pressure. Therefore, it is concluded that the method of the present invention is advantageous in terms of human health promoting function.

[Table 2]

Fatty acid composition (%) of chicken breast meat added with olive oil and soy sauce and treated by high hydrostatic pressure processing

Fatty acid composition	Treatment						Standard error
	Control group	300 MPa	Olive oil (10%) /600 MPa	Soy sauce (10%) /300 MPa	Olive oil (10%) /300 MPa	Soy sauce (5%)+ Olive oil (5%)/300 MPa	
C16:0	24.58b	25.02b	23.44bc	22.71c	26.73a	23.57bc	0.483
C16:1	3.08b	3.28b	3.46b	3.61b	4.81a	3.66b	0.248
C18:0	13.22a	12.99a	12.58a	13.42a	8.98b	11.14a	0.697
C18:1	39.60bc	34.06d	41.88a	38.04c	38.34bc	40.43ab	0.689
C18:2	14.62cd	18.30a	13.69d	16.97ab	16.59b	15.74bc	0.450
C18:3	0.36	0.34	0.31	0.37	0.39	0.30	0.038
C20:4	3.86bc	5.31a	3.66c	4.27bc	3.57c	4.62ab	0.271
C22:6	0.65b	0.67b	0.96a	0.58b	0.56b	0.52b	0.069
Saturated	37.80a	38.02a	36.02b	36.13b	35.72b	34.71b	0.508
Monounsaturated	42.69ab	37.34c	45.34a	41.66b	43.15ab	44.09ab	0.828
Polyunsaturated	19.51cd	24.63a	18.63d	22.20b	21.12bc	21.19bc	0.588
Unsaturated : Saturated	1.64b	1.63b	1.77a	1.77a	1.80a	1.88a	0.038

a-d: different letters in the same row indicate a significant difference ($P<0.05$).

Example 3: pH of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

There was no significant change in pH after adding soy sauce and olive oil to chicken breast meat followed by high hydrostatic pressure (Table 3). pH is a major determinant of meat quality, tenderness, lower pH is preferred.

[Table 3]

pH of chicken breast meat after addition of olive oil and soy sauce and treatment with high hydrostatic pressure processing

Treatment group	pH
Control group	6.24
Soy sauce (10%)/300 MPa	6.15
Olive oil (10%)/300 MPa	6.14
Soy sauce (5%) + olive oil (5%)/300 MPa	6.17
Standard error	0.037

Example 4: Surface color of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Results indicate that brighter meat color was obtained compared to the control group as the result of addition of olive oil. On the other hand, darker color was obtained when soy sauce was added. Addition of olive oil or soy sauce results in color change of at least 8 units, which can be visually determined and is significantly different from the control group.

[Table 4]

Surface color of chicken breast meat added with olive oil and soy sauce and treated by high hydrostatic pressure processing

Treatment group	Lightness (L*-value)	Redness (a*-value)	Yellowness (b*-value)	Color change (ΔE)
Control group	52.94d	0.40c	10.24b	
Soy sauce (10%)/300 MPa	58.97c	4.32a	15.28a	8.78
Olive oil (10%)/300 MPa	71.58a	1.56bc	12.06b	18.76
Soy sauce (5%) + olive oil (5%)/300 MPa	63.55b	3.41b	16.39a	12.62
Standard error	0.891	0.695	0.824	

a-d: different letters in the same column indicate a significant difference ($P<0.05$).

Example 5: Lipid oxidation (TBARS) in chicken breast meat treated with olive oil and soy sauce and high hydrostatic pressure processing

In the control group, lipid oxidation increased as the storage period increased (Table5). When olive oil was added (10%), the lipid oxidation developed similarly to the control group, no significant difference was found between the groups. However, addition of soy sauce 'appears' to cause higher lipid oxidation than the control. This may be because the color of soy sauce affects the TBARS test, resulting in an 'apparent' increase in lipid oxidation.

[Table 5]

Lipid oxidation (TBARS) of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Treatment group	Storage period (day)			Standard error
	0	3	7	
Control group	0.28bz	0.48ay	0.47az	0.056
Soy sauce (10%)/300 MPa	0.91bx	1.02aw	1.05ax	0.033
Olive oil (10%)/300 MPa	0.29bz	0.36bz	0.48az	0.030
Soy sauce (5%) + olive oil (5%)/300 MPa	0.56cy	0.69bx	0.86ay	0.024
Standard error	0.025	0.038	0.047	

a-c: different letters in the same row indicate a significant difference ($P<0.05$).

x-z: different letters in the same column indicate a significant difference ($P<0.05$).

Example 6: Volatile basic nitrogen (VBN) content in chicken breast meat treated with olive oil and soy sauce and high hydrostatic pressure processing

The VBN content was lower in the samples with added soy sauce or olive oil than the control group (Table 6). However, in all the treatment groups, the VBN content increased as the storage period increased ($p<0.05$). It is believed that protein degradation was retarded by anti-oxidants such as flavone, amino acids, peptides and melanodin, components of the soy sauce. It was also found that the protein degradation was retarded by the addition of olive oil. Generally, meat experiences rigor mortis and aging processes after completion of the rigor mortis. During aging, the enzymes present in muscle or secreted by various microorganisms degrade proteins in meat, as a result free amino acids and non-protein nitrogen compounds increase.

[Table 6]

The content of volatile basic nitrogen (mg%) in chicken breast meat treated with olive oil, soy sauce and by high hydrostatic pressure processing

Treatment group	Storage period (day)			Standard error
	0	3	7	
Control group	14.70cy	27.30bx	65.80ax	1.189
Soy sauce (10%)/300 MPa	18.90bx	22.40ay	24.50ay	0.873
Olive oil (10%)/300 MPa	15.40by	18.20abz	22.40ay	1.319
Soy sauce (5%) + olive oil (5%)/300 MPa	16.80bxy	17.50bz	23.80ay	0.617
Standard error	0.857	1.178	1.050	

a-b: different letters in the same row indicate a significant difference ($P<0.05$).

x-z: different letters in the same column indicate a significant difference (P<0.05).

Example 7: Inactivation of pathogens in chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

The addition of olive oil and soy sauce followed by high hydrostatic pressure processing decreased the population of pathogens to the level of 1 to 2 log cycle. In addition, during storage the all treatment groups inhibited microbial growth, indicating that the present invention improves the safety of the meat.

[Table 7]

Number of pathogens (CFU/g) inoculated in chicken breast meat treated with olive oil, soy sauce and high hydrostatic pressure processing

Microorganisms	Treatment group	Storage period (day)				Standard error
		0	3	7	14	
Escherichia coli KCTC 1682	control group	*8.45x*	*7.98x*	*7.84x*	*8.01x*	*0.163*
	soy sauce (10%)/300 MPa	5.78by	5.17cy	5.81by	6.39ay	0.130
	olive oil (10%)/300 MPa	6.11ay	5.24by	6.17ay	6.49ay	0.218
	soy sauce (5%) + olive oil (5%)/300 MPa	5.48by	5.33by	6.19ay	6.45ay	0.159
	standard error	0.201	0.206	0.147	0.108	
Salmonella TyphimuriumKCTC 1925	control group	6.17x	6.74x	6.69x	6.84	0.347
	soy sauce (10%)/300 MPa	5.50y	4.60y	4.95y	5.85	0.347
	olive oil (10%)/300 MPa	6.33ax	4.81by	5.14aby	5.80ab	0.363
	soy sauce (5%) + olive oil (5%)/300 MPa	6.70ax	5.47bxy	5.54bxy	6.20ab	0.286
	standard error	0.160	0.451	0.332	0.340	
Listeria monocytogenes KCTC 3569	control group	7.35ax	6.08bx	5.63bxy	6.92ax	0.114
	soy sauce (10%)/300 MPa	5.58y	5.60x	5.13y	5.65y	0.266
	olive oil (10%)/300 MPa	4.54by	4.43by	5.85ax	5.48aby	0.315
	soy sauce (5%) + olive oil (5%)/300 MPa	5.48y	5.70x	5.58xy	5.69y	0.209
	standard error	0.273	0.216	0.150	0.289	

a-b: different letters in the same row indicate a significant difference (P<0.05).

x-z: different letters in the same column indicate a significant difference (P<0.05).

Example 8: Texture characteristics of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Under the same condition of high hydrostatic pressure processing, there was no significant difference between the control group and the treatment group (Table 8). This result supports the conclusion that the penetration of oil, soy sauce and others used for the present invention into the inside of meat is advantageous as it can avoid the problem of increased toughness and reduced tenderness generally recognized by high hydrostatic pressure processing.

[Table 8]

Texture characteristics of the chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

Treatment group	Toughness (kg)	Adhesiveness	Resiliency	Cohesiveness	Gum property	Chewiness	Recovery
Control group	28.0	-357	0.37	0.17	4.93	1.77	0.10
300 MPa	30.1	-322	0.32	0.25	7.83	2.72	0.14
Soy sauce (10%)/300 MPa	29.9	-495	0.30	0.23	7.14	2.15	0.13
Olive oil (10%)/300 MPa	29.7	-476	0.29	0.18	5.40	1.51	0.19
Soy sauce (5%+olive oil (5%)/300 MPa	23.9	-414	0.30	0.23	4.27	1.29	0.09
Standard error	2.96	63.00	0.036	0.023	1.205	0.527	0.015

Example 9: Sensory evaluation of chicken breast meat treated with olive oil, soy sauce and high hydrostatic pressure processing

According to the sensory evaluation based on preference test, the treatment group with the mixture of soy sauce (5%) and olive oil (5%) has significantly better surface color than the control group (Table 9). In addition, due to the increased oleic acid content in treated group, flavor and aroma were enhanced. The tenderness varied depending on the age of the sensory panel. For example, the consumer panel of 18-25 years of age scored lower tenderness for the sample with olive oil compared to the control, suggesting softer texture. However, the consumer panel of 40-50 years of age

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showed no significant difference between the sample and the control. Finally, it was determined that the addition of olive oil to chicken breast meat increased the content of oleic acid, which can lower the melting point of fat, and therefore enhanced the tenderness and juiciness of the chicken breast meat. With these quality characteristics, consumer preference increased for the product treated with the high hydrostatic pressure processing. It was found that the willingness to buy was higher for the product with added olive oil and processed with high hydrostatic pressure compared to the control group.

[Table 9]

Sensory evaluation of chicken breast meat with added olive oil and soy sauce and treated by high hydrostatic pressure processing

	Control group	300 MPa	Olive oil (10%)/300 MPa	Soy sauce (5%) + Olive oil (5%) /300 MPa	Soy sauce (10%)/300 MPa	Standard error
Surface color	3.10ab	2.81ab	2.50a	4.40c	4.83c	0.37
Aroma	3.90a	4.03a	3.83a	5.70b	5.56b	0.47
Tenderness (1)	6.87a	4.37b	5.72ab	6.37ab	6.15ab	1.02
Tenderness (2)	7.00a	7.21a	5.85a	6.50a	6.28a	1.33
Juiciness	6.67ac	5.32b	6.74ac	6.02c	7.07a	0.44
Chewiness	6.00a	4.64b	6.20a	6.37a	6.94a	0.56
Flavor	5.20ab	4.24b	6.06a	5.36a	5.06ab	0.48
Overall acceptance	5.13ab	4.24b	6.06a	5.42a	5.26ab	0.43
Willingness to buy	4.15b	3.58b	5.42a	4.74ab	4.68ab	0.48

(1) subject: 19 to 29 year old college students

(2) subject: 40 to 50 year old housewives

Taken all together, to solve the problems relating to the factors which may impair quality of non-comminuted meat products including color and texture deterioration, etc, which occurs during pasteurization of meat products, soy sauce and olive oil can be added before the high hydrostatic pressure processing according to the present invention. As a result, surface color of the non-comminuted meat products can be improved. Further, due to the higher level of unsaturated fatty acid in the treated

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meat product by addition of olive oil, the healthier meat goods can be provided. In particular, oleic acid is found to have a large influence on flavor after cooking, this may improve consumers' choice. Further, the high hydrostatic pressure processing can solve various problems that may occur during processing, distribution and storage of meat products. Compared to a conventional marination method in which meat is immersed for more than 12 hours in a seasoning solution (i.e., curing solution) or treated for 30 minutes or so in a high hydrostatic pressure machine, the method of the present invention can shorten the processing time to less than 5 minutes. Furthermore, with a simplified production process, a favorable economic effect would be expected. In addition, according to the high hydrostatic pressure processing, it was also found that the finished products of the present invention have an excellent effect on inactivation and suppression of the growth of pathogenic microorganisms. Therefore, both safety and storage stability are dramatically increased. In particular, addition of soy sauce and olive oil is expected to increase consumer preference, at the same time providing healthier food products comprising elevated levels of unsaturated fatty acid. The method described in the present invention and can be applied to various kinds of non-comminuted meat products.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of producing high quality non-comminuted meat products comprising adding at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce to non-comminuted meat, vacuum packaging and processing the product under high hydrostatic pressure.

2. The method according to Claim 1, wherein said non-comminuted meat is pork, beef, sheep meat, chicken meat, goat meat, duck meat, turkey meat, horse meat, dog meat, kangaroo meat or fish.

3. The method according to any one of the preceding claims, wherein said vegetable oil is olive oil, grape seed oil, linseed oil, canola oil, castor oil, evening primrose oil, soybean oil, tung oil, hashish oil, rapeseed oil or palm oil, and said animal fat is tallow, lard or chicken fat.

4. The method according to any one of the preceding claims, wherein said seasoning sauce is soy sauce.

5. The method according to any one of the preceding claims, wherein said high hydrostatic pressure processing is carried out under 250 to 650 MPa for 2 to 25 minutes.

6. The method according to any one of the preceding claims, wherein said product is distinguished by improved marbling/intramuscular fat content in non-comminuted meat.

7. The method according to claim 1, wherein it comprises the following steps:

- adding at least one ingredient selected from the group consisting of vegetable or animal oil or fat and seasoning sauce to the non-comminuted meat in an amount of 0 to 15% (w/w) on the basis of the weight of the non-comminuted meat, and vacuum packaging the meat; and
- processing the vacuum packaged non-comminuted meat under high hydrostatic pressure of 250 to 650 MPa for 2 to 25 minutes.

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8. High quality non-comminuted meat products that are produced according to the method described in any one of Claims 1 to 7.

9. A method of producing high quality non-comminuted meat products or high quality non-comminuted meat products when produced by the method, substantially as herein described with reference to any one or more of the examples but excluding comparative examples.