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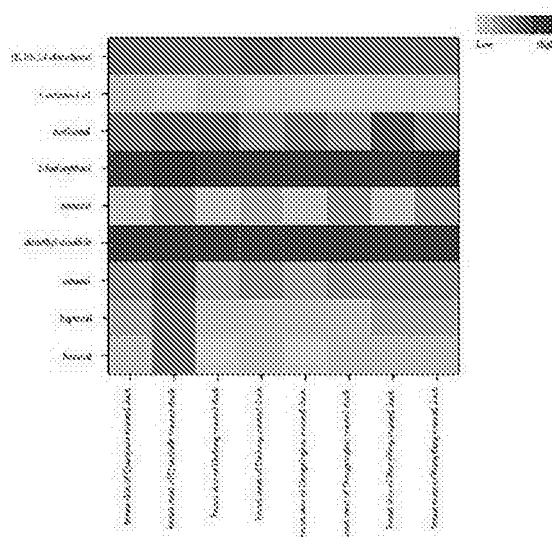
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54 IDENTIFICATION METHOD OF CHARACTERISTIC VOLATILE COMPOUNDS IN MEAT OR MEAT PRODUCTS

57 The present invention discloses a identification method of characteristic volatile compounds in meat or meat products, including: extracting volatile compounds from meat or meat products and detecting each component concentration; calculating odor activity value and contribution rate of each component; selecting N components whose cumulative contribution rate and odor activity value is respectively greater than preset value a and b; preparing a recombination model 1 of N components standard sample and odorless meat or meat products material, deleting one of N components, and preparing a recombination model 2 with odorless meat or meat products materials, comparing flavor of recombination model 1 with 2, wherein component caused difference in flavor is characteristic volatile compound of meat or meat products. The present invention can avoid inaccurate drawback of traditional method by single gas chromatography-olfactometry-mass spectrometry, and can accurately and quickly identify volatile compounds of meat or meat products,



IDENTIFICATION METHOD OF CHARACTERISTIC VOLATILE COMPOUNDS IN MEAT OR MEAT PRODUCTS

TECHNICAL FIELD

[0001] The present invention relates to the field of food inspection technology. More specifically, the present invention relates to an identification method of characteristic volatile compounds in meat or meat products.

BACKGROUND

[0002] Traditional meat products are Chinese business cards and treasure of Chinese diet culture, especially barbecue, pot-stewed and cured products. Traditional meat products have unique and rich flavors, which are popular among consumers, and their flavor and volatile compounds are related. The determination of volatile compound is not only related to its content, but also closely related to its extraction and analysis methods. The traditional method for identifying characteristic volatile compounds contains quantitative analysis combined with gas chromatography-mass spectrometry, and determination of odor activity value. The above traditional method has certain drawbacks. Gas chromatography-mass spectrometry is only used to clarify the components of the volatile compounds and their relative contents, and lacks subjective sensory evaluation. The accuracy of the volatile compounds by determination of odor activity value is not enough and further verification is lacking. For example, such as the odor activity value of 2-methylbutanal is greater than 1, but this compound does not contribute significantly to the overall flavor of the meat or meat products. Accordingly, a rapid and accurate method for identifying characteristic volatile compounds in meat or meat products is needed in this field.

DESCRIPTION

[0003] A purpose of the present invention is to solve at least above problems, and to provide, at least, the advantages that will be described later.

[0004] Another purpose of the present invention is to provide an identification method of characteristic volatile compounds in meat or meat products, which uses

headspace solid phase microextraction combined with gas chromatography-olfactometry-mass spectrometry to detect volatile compounds in meat or meat products. The volatile compounds in meat or meat products are analyzed by contribution rate and cumulative contribution rate method, and the characteristic
5 volatile compounds are identified by recombination model, thereby solving the problem that identification method of characteristic volatile compounds in the prior art is not accurate.

[0005] In view of purposes mentioned above and other advantages, the present invention provides an identification method of characteristic volatile compounds in
10 meat or meat products, including the following steps:

[0006] step one, extracting volatile compounds from meat or meat products and detecting concentration of each component in volatile compounds;

[0007] step two, calculating odor activity value of each component, and obtaining contribution rate of each component according to the ratio of the odor activity value
15 of each component to sum of odor activity value of all components;

[0008] step three, sorting the contribution rate of each component in descending order, selecting M components whose cumulative contribution rate is greater than preset value a in the descending order, and then selecting N components whose odor activity value is greater than preset value b from the M components having
20 cumulative contribution rate greater than preset value a;

[0009] step four, preparing odorless meat or meat products material, preparing a mixed standard solution 1 of the N components obtained in the step three according to the concentration of each component in the step one, adding the mixed standard solution 1 into the odorless meat or meat products material to form a recombination
25 model 1, deleting one of the N components obtained in the step three, preparing a mixed standard solution 2 of remaining components according to the concentration of each component in the step one, adding the mixed standard solution 2 into the odorless meat or meat products materials to form a recombination model 2, comparing flavor of the recombination model 1 with the recombination model 2, wherein volatile
30 compound that causes difference in flavor is characteristic volatile flavor substance of

meat or meat products.

[00010] Preferably, apparatus for detecting volatile compounds is a gas chromatography-olfactometry-mass spectrometry, wherein heating process of the gas chromatography-olfactometry-mass spectrometry is: initial column temperature T_1 °C, 5 keeping t_1 min, heating to T_2 °C at a rate of v_1 °C/min, heating to T_3 °C at a rate of v_2 °C/min, heating to T_4 °C at a rate of v_3 °C/min, and keeping t_2 min, wherein T_1 is smaller than or equal to 40, t_1 is greater than or equal to 3, T_2 is greater than or equal to 60 and smaller than or equal to 80, T_3 is greater than or equal to 120 and smaller than or equal to 140, T_4 is greater than or equal to 230, t_2 is greater than or equal to 3, 10 and v_2 is greater than v_1 and smaller than v_3 .

[00011] Preferably, the extraction method of volatile compounds from meat or meat products is a headspace solid phase microextraction method, and the extraction process comprises: weighing meat or meat products, adding saturated sodium chloride solution to meat or meat products in a ratio of 1 mL : 1 g, adding a standard of 15 organic compound, stirring, preheating at 40-60 °C for 8-15 min, and adsorbing by CAR/PDMS extraction fiber at 40-60 °C for 40-60 min.

[00012] Preferably, the process of qualitatively detecting volatile compounds by the gas chromatography-olfactometry-mass spectrometry includes: retrieving by a mass spectrometry library, calculating retention index, analyzing by sniffer, and performing 20 standard qualitative analysis to obtain specific components of volatile compounds.

[00013] Preferably, the process of quantitatively detecting the concentration of each component in volatile compounds by the gas chromatography-olfactometry-mass spectrometry includes: preparing a plurality of odorless meat or meat products materials, detecting each component in volatile compounds by the gas 25 chromatography-olfactometry-mass spectrometry, taking standard to prepare mixed standard solution 3 with different concentration, adding the mixed standard solution 3 into a plurality of odorless meat or meat products materials, extracting volatile compounds of each meat or meat products material containing the mixed standard solution 3 by headspace solid phase microextraction, detecting peak area of

characteristic ion fragments of each component by the gas chromatography-olfactometry-mass spectrometry, establishing a standard curve equation between the peak area of characteristic ion fragments and the concentration of each component in volatile compounds, and determining the concentration of each component in volatile compounds of meat or meat products according to the peak area of characteristic ion fragments of each component in volatile compounds of meat or meat products by the gas chromatography-olfactometry-mass spectrometry.

[00014] Preferably, preparation method of odorless meat or meat products material includes: weighing meat or meat products, mixing the meat or meat products, diethyl ether and n-pentane in a ratio of 1 g : 2 mL : 1 mL, shaking in a shaker, filtering, removing organic solution, repeating operation several times until the meat or meat products are odorless, freeze-drying odorless meat or meat products, and adding purified water is added, wherein amount of the purified water is consistent with water content of the meat or meat products.

[00015] Preferably, method for comparing flavor of the recombination model 1 with the recombination model 2 is sensory triangular test.

[00016] Preferably, the preset value a is 90%, and the preset value b is 1.

[00017] Preferably, capillary column of the gas chromatography-olfactometry-mass spectrometry is DB-Wax, and the heating process includes: keeping at initial column temperature 40 °C for 3 min, heating to 70 °C at a rate of 2 °C/min, heating to 130 °C at a rate of 3 °C/min, heating to 230 °C at a rate of 10 °C/min, and keeping 10 min.

[00018] Preferably, the process for extracting volatile compounds from meat or meat products includes: weighing meat or meat products, adding saturated sodium chloride solution to the meat or meat products in a ratio of 1 mL : 1 g, adding 2-methyl-3-heptanone standard, placing a magnetic rotor, performing magnetic stirring, preheating at 55 °C for 10 min, and finally adsorbing by a 75 μm CAR/PDMS extraction fiber at 55 °C for 45 min.

[00019] The present invention includes at least the following advantages:

[00020] First, the contribution rate method used in the present invention can initially obtain volatile compounds having a large contribution rate of meat or meat products,

and the cumulative contribution rate method can determine volatile compounds having a larger contribution rate of meat or meat products.

[00021] Second, Combination of detecting and recombination model used in the present invention can avoid inaccurate drawback of traditional method by single gas chromatography-olfactometry-mass spectrometry, and the present invention can accurately identify volatile compounds of meat or meat products, and have high accuracy rate.

[00022] Third, the heating process of the gas chromatography-olfactometry-mass spectrometry is deeply optimized in the present invention, so that types and contents of volatile compounds detected are significantly increased, and extraction effect of volatile compounds is improved.

[00023] Fourth, meat or meat products in the present invention are added a saturated sodium chloride solution, and stirred with a magnetic stirring device to better release volatile compounds, by which the content of volatile compounds is significantly increased, and the extraction effect of volatile compounds is improved. The 2-methyl-3-heptanone standard sample is used as an internal standard substance, which is more suitable for extraction of volatile compounds in meat or meat products, so that detection accuracy of volatile compounds is greatly improved.

[00024] Other advantages, objects, and features of the present invention will be showed in part through following description, and in part will be understood by those skilled in the art from study and practice of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[00025] Fig. 1 is a chromatogram of volatile compounds in meat or meat products according to an embodiment of the present invention.

[00026] Fig. 2 is a chromatogram of volatile compounds in meat or meat products according to comparative example 2 of the present invention.

[00027] Fig. 3 is a chromatogram of volatile compounds in meat or meat products according to comparative example 3 of the present invention.

[00028] Fig. 4 is a standard curve and standard curve equation of 1-octene-3-ol in volatile compounds according to the embodiment of the present invention.

[00029] Fig. 5 is a standard curve and standard curve equation of nonanal in volatile compounds according to the embodiment of the present invention.

5 [00030] Fig. 6 is a standard curve and standard curve equation of dimethyltrisulfide in volatile compounds according to the embodiment of the present invention.

[00031] Fig. 7 is a standard curve and standard curve equation of guaiacol in volatile compounds according to the embodiment of the present invention.

[00032] Fig. 8 is a thermal image of odor activity value of components having a
10 cumulative contribution rate greater than 90% and a odor activity value greater than 1 in volatile compounds according to the embodiment of the present invention.

[00033] Fig. 9 is a thermal image of contribution rate of components having a cumulative contribution rate greater than 90% and a odor activity value greater than 1 in volatile compounds according to the embodiment of the present invention.

15 [00034] Fig. 10 is a thermal image of odor activity value of 9 components having a cumulative contribution rate greater than 90% and a odor activity value greater than 1 in volatile compounds according to the embodiment of the present invention.

[00035] Fig. 11 is a diagram showing flavor characteristics of characteristic volatile compounds according to the embodiment of the present invention.

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DETAILED DESCRIPTION

[00036] The present invention will now be described in further detail with reference to the accompanying drawings in order to enable person skilled in the art to practice
25 with reference to the description.

[00037] It should be noted that experimental methods described in the following embodiments are all conventional methods unless otherwise specified, and reagents and materials are commercially available unless otherwise specified. It should be noted that in the description of the present invention, the terms of "transverse ",
30 "longitudinal ", "up", "down", "front", "behind", "left", "right", "vertical", "horizontal",

"top", "bottom", "inner", "outer" and the like are based on the orientation or positional relationship shown in the drawings for convenience of describing the present invention and simplifying description. It is not intended or implied that the device or element must have a particular orientation and be constructed and operated in a particular orientation, and therefore it should not be construed as limiting the present invention.

[00038] Embodiment

[00039] Specific flow of the embodiment will only be described below. In fact, inventors have identified samples of different brands of meat products by the following embodiment.

[00040] step one, weighing 4 g of meat (duck breast skin or duck breast) in a 20 mL sample vial, adding 4 mL of saturated sodium chloride solution, adding 1.5 μ L of 2-methyl-3-heptanone, performing magnetic stirring, preheating at 55 °C for 10 min, and finally adsorbing at 55 °C for 45 min through a 75 μ m CAR/PDMS extraction fiber.

[00041] step two, taking out of the extraction fiber, quickly inserting into an inlet of a gas chromatography-olfactometry-mass spectrometry, and then starting the gas chromatography-olfactometry-mass spectrometry to collect data, wherein capillary column of the gas chromatography-sniffer-mass spectrometry was DB-Wax (30 m \times 320 μ m \times 0.25 μ m) and uses non-diversion mode injection, flow rate of carrier gas (He) was 1.0 mL / min, temperature of the sniffer was 230 °C, and the heating process included: keeping at initial column temperature 40 °C for 3 min, heating to 70 °C at a rate of 2 °C/min, heating to 130 °C at a rate of 3 °C/min, heating to 230 °C at a rate of 10 °C/min, and keeping 10 min.

[00042] Mass spectrometry conditions: ionization energy: EI; scanning range m/z: 50-500; ion source temperature: 230 °C; scanning frequency: 1.7 times / sec.

[00043] The chromatogram of obtained volatile compounds was shown as Fig. 1.

[00044] Qualitative analysis of volatile compounds:

[00045] (1) retrieving by a mass spectrometry library: experimental data processing was performed by the Agilent Masshunter Qualitative Analysis software system. The

computer search of unknown compounds was matched with the NIST MS 2.0 library, and identification result was only reported when positive and negative matching degrees were greater than 800 (maximum value was 1000).

[00046] (2) calculating retention index: the same heating process as in the step two was used, 2-methyl-3-heptanone was used as a standard, the retention index of volatile compounds in meat or meat products were calculated by retention time, and retention index (RI) of compounds in referred literature was compared with the retention index of volatile compounds in meat or meat products.

[00047] Formula for calculating the retention index RI was: $RI = 100n + 100(t_x - t_n) / (t_{n+1} - t_n)$, wherein n was the number of carbon, t_x , t_n and t_{n+1} were respectively peak time of unknown volatile flavor substance, C_n and C_{n+1} , and t_x was greater than t_n and less than t_{n+1}

[00048] (3) analyzing by the sniffer: volatile compounds separated by the gas chromatography were entered into a mass spectrometry detector and the sniffer in a ratio of 1:1. A sensory evaluator sniffs and records the characteristics and intensity of volatile compounds. On this basis, sniffing results was compared with flavor characteristics of the standard of substance.

[00049] (4) performing qualitative analysis of the standard sample: using mixed standard of the standards of volatile compounds as an external standard, detecting according to GC-MS heating process of sample, comparing and analyzing the peak time of the standard sample and the peak time of the volatile compounds.

[00050] Components of volatile compounds determined by combination of mass spectrometry library, retention index calculation, sniffer analysis and qualitative analysis of the standards contained 42 kinds of volatile compounds, including aldehydes and sulfur-containing compounds, alcohols, ketones, phenols, acids and nitrogen-containing compounds, wherein aldehydes (16 species) are mainly pentanal, hexanal, (*E, E*)-2,4-decadienal etc., sulfur-containing compounds (3 species) are dimethyl trisulfide, 2-furfurylthiol and methional.

[00051] Quantitative analysis of volatile compounds:

[00052] (1) preparation method of odorless meat or meat products material included:

weighing meat or meat products, mixing the meat or meat products, diethyl ether and n-pentane in a ratio of 1 g : 2 mL : 1 mL, shaking in a shaker for 8 h, filtering for removing organic solution, repeating operation several times until the meat or meat products was odorless, freeze-drying odorless meat or meat products for 12 h, and adding purified water was added, wherein amount of the purified water was consistent with water content of the meat or meat products, and the water content of the meat or meat products was determined by the quality difference of samples before and after freeze-drying.

[00053] (2) each component of volatile compounds detected by the gas chromatography-olfactometry-mass spectrometry was prepared as a standard solution of 10 mg/g by methanol (wherein the standard solution contained all components of volatile compounds, and each component had a concentration of 10 mg/g). The standard solution was then diluted to a mixed standard solution 3 with different concentrations (eg 1 mg/g, 500 ng/g, 250 ng/g, 100 ng/g, 50 ng/g, 25 ng/g, 10 ng/g, 5 ng/ and 1 ng/g, etc.), and the mixed standard solution 3 with different concentrations was added into a plurality of odorless meat or meat products materials, extracting volatile compounds of each meat or meat products material containing the mixed standard solution 3 by headspace solid phase microextraction, detecting peak area of characteristic ion fragments of each component by the gas chromatography-olfactometry-mass spectrometry, establishing a standard curve equation between the peak area of characteristic ion fragments and the concentration of each component in volatile compounds, and determining the concentration of each component in volatile compounds of meat or meat products according to the peak area of characteristic ion fragments of each component in volatile compounds of meat or meat products by the gas chromatography-olfactometry-mass spectrometry.

[00054] Since there were many components of volatile compounds, standard curves and standard curve equations of the four components of 1-octene-3-ol, nonanal, dimethyl trisulfide and guaiacol and their standard curve equations were only described below, as shown in Fig. 4-7.

[00055] The standard curve equation of 1-octene-3-ol was $y=3 \times 10^{-5}x-19.883$, wherein correlation coefficient R^2 was 0.9937.

[00056] The standard curve equation of nonanal was $y=8 \times 10^{-5}x-358.28$, wherein correlation coefficient R^2 was 0.9923.

5 [00057] The standard curve equation of dimethyltrisulfide was $y=3 \times 10^{-5}x-6.4727$, wherein correlation coefficient R^2 was 0.9998.

[00058] The standard curve equation of guaiacol was $y=2 \times 10^{-5}x-6.8828$, wherein correlation coefficient R^2 was 0.9961.

[00059] Step three, analysis of contribution rate of each component in volatile
10 compounds: odor activity value of each component was calculated by ratio of the concentration of each component to the threshold (the threshold of each component was referred through relevant literature: ZHU J, CHEN F, WANG L, et al. Characterization of the Key Aroma Volatile Compounds in Cranberry (*Vaccinium macrocarpon* Ait) Using Gas Chromatography-Olfactometry (GC-O) and Odor
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CHRISTLBAUER M, SCHIEBERLE P. Evaluation of the key aroma compounds in beef and pork vegetable gravies a la chef by stable isotope dilution assays and aroma
30 recombination experiments [J]. *Journal of Agricultural & Food Chemistry*, 2011,

59(24):13122-13130. DOI: 10.1021/jf203340a, etc.), the contribution ratio of each component was obtained according to the ratio of odor activity value of the single component to the sum of odor activity values of all components, and compound with larger contribution rate was more important.

5 [00060] Step 4: Analysis of cumulative contribution rate of each component in volatile compounds: the contribution rate of each component was sorted in order of largest to smallest, and components having a cumulative contribution rate greater than 90% were selected in descending order, and components having an odor activity value greater than 1 were selected from the components having a cumulative contribution
10 rate greater than 90%.

[00061] As shown in Fig. 1, inventors listed contribution rate and cumulative contribution rate of volatile compounds of some branded roast duck meat samples having a cumulative contribution rate greater than 90% and an odor activity value greater than 1.

15 [00062] Table 1

[00063]

	Quanjudu		Dadong roasted		Dongxinglou		Bianyifang	
	roasted duck		duck		roasted duck		roasted duck	
	Breas	Breast	Breast	Breast	Breast	Breast	Breast	Breast
	t skin	meat	skin	meat	skin	meat	skin	meat
pentanal	0.13	0.04	0.00	0.01	0.00	0.01	0.02	0.01
hexanal	0.32	0.45	0.02	0.10	0.03	0.07	0.08	0.05
heptanal	1.01	0.67	0.13	0.16	0.22	0.11	0.42	0.12
(E)-2-hexenal	0.06	0.01	0.01	0.00	0.01	0.00	0.02	0.00
2-pentylfuran	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00
octanal	1.98	0.94	0.74	0.71	0.87	0.55	1.10	0.41
(E)-2-heptenal	0.13	0.02	0.08	0.02	0.05	0.01	0.08	0.01
dimethyl								
trisulfide	40.51	41.42	32.10	26.50	27.53	27.56	35.62	28.34

nonanal	0.40	0.31	0.19	0.52	0.18	0.44	0.29	0.34
2-furfurylthiol	43.54	53.69	57.03	65.44	59.54	68.41	49.28	68.05
(<i>E</i>)-2- octenal	0.25	0.18	0.10	0.23	0.20	0.03	0.14	0.14
methional	4.90	1.20	5.24	0.79	4.25	0.46	8.24	0.76
1-octen-3-ol	0.21	0.01	0.12	0.04	0.06	0.02	0.04	0.01
(<i>E</i>)-2- nonenal	1.24	0.35	0.54	1.26	0.79	0.66	0.81	0.49
phenyl								
acetaldehyde	0.12	0.02	0.32	0.06	0.37	0.05	0.20	0.03
(<i>E</i>)-2-decenal	0.38	0.13	0.50	0.99	0.82	0.35	0.67	0.37
(<i>E,E</i>)-2,4-deca								
dienal	4.52	0.53	2.86	3.14	4.99	1.25	2.92	0.87
guaiacol	0.26	0.01	0.01	0.00	0.07	0.02	0.03	0.01
Cumulative								
contribution								
rate (%)	99.98	100.00	99.98	100.00	99.99	100.00	99.99	100.00

[00064] Step five, preparing odorless meat or meat products material (method was the same as above), preparing a mixed standard solution 1 of the 18 components obtained in the step four according to the concentration of each component in the step one (the mixed standard solution contained the 18 components, and the concentration of each component was the same as that detected in the step two), adding the mixed standard solution 1 into the odorless meat or meat products material to form a recombination model 1, deleting one of the 18 components obtained in the step four, preparing a mixed standard solution 2 of remaining components according to the concentration of each component in the step one, adding the mixed standard solution 2 into the odorless meat or meat products materials to form a recombination model 2, comparing flavor of the recombination model 1 with the recombination model 2, wherein method for comparing flavor of the recombination model 1 with the recombination model 2 was sensory triangular test, and volatile compound that caused difference in flavor was characteristic volatile compound of meat or meat products. If component that did

not cause difference in flavor was removed, and component that caused difference in flavor was retained, a recombinant model 3 was continued to prepare. If the flavor of the recombinant model 3 is basically same as the flavor of meat or meat products, the retained component was characteristic volatile compound of all meat or meat products, and then analyzing to determine flavor characteristics of meat or meat products, as shown in Fig. 11.

[00065] Comparative example 1

[00066] step one and step two were the same as that of the embodiment, and there were no step three, step four, and step five.

10 [00067] Comparative example 2

[00068] step one was the same as that of the embodiment

[00069] step two, taking out of the extraction fiber, quickly inserting into an inlet of a gas chromatography-olfactometry-mass spectrometry, and then starting the gas chromatography-olfactometry-mass spectrometry to collect data, wherein capillary column of the gas chromatography-olfactometry-mass spectrometry was HP-5MS (30 m × 0.25 mm × 0.25 μm) and uses non-diversion mode injection, flow rate of carrier gas (He) was 1.0 mL / min, temperature of the sniffer was 230 °C, and the heating process included: keeping at initial column temperature 40 °C for 3 min, heating to 70 °C at a rate of 3 °C/min, heating to 180 °C at a rate of 5 °C/min, heating to 230 °C at a rate of 10 °C/min, and keeping 5 min.

[00070] Mass spectrometry conditions, qualitative analysis of volatile compounds, quantitative analysis of volatile compounds and odor activity value were the same as those in the embodiment.

[00071] The chromatogram of obtained volatile compounds was shown in Fig. 2.

25 [00072] Comparative example 3

[00073] step one was the same as that of the embodiment

[00074] step two, taking out of the extraction fiber, quickly inserting into an inlet of a gas chromatography-olfactometry-mass spectrometry, and then starting the gas chromatography-olfactometry-mass spectrometry to collect data, wherein capillary column of the gas chromatography-olfactometry-mass spectrometry was HP-5MS (30

m × 0.25 mm × 0.25 μm) and uses non-diversion mode injection, flow rate of carrier gas (He) was 1.0 mL / min, temperature of the sniffer was 230 °C, and the heating process included: keeping at initial column temperature 40 °C for 2 min, heating to 70 °C at a rate of 2 °C/min, heating to 130 °C at a rate of 3 °C/min, heating to 230 °C at a rate of 10 °C/min.

[00075] Mass spectrometry conditions, qualitative analysis of volatile compounds, quantitative analysis of volatile compounds and odor activity value were the same as those in the embodiment.

[00076] The chromatogram of obtained volatile compounds was shown in Fig. 3.

10 [00077] Result analysis

[00078] Chromatogram analysis

[00079] As shown in Fig. 1, Fig. 2 and Fig. 3, various components of volatile compounds of the embodiment (Fig. 1) can be well separated, the chromatogram of the embodiment had not overlapping peaks and heavy-tailed phenomenon, and the number of peaks was large. The peak shape of various components in volatile compounds of comparative example 2 (Fig. 2) and comparative example 3 (Fig. 3) was not well separated, chromatograms had heavy overlapping peaks and heavy-tailed phenomenon, and the number of peaks was small. The above indicated that gas chromatography column polarity and heating process significantly affected analytical ability of volatile compounds in meat or meat products. A total of 42 volatile compounds were detected in the embodiments, including aldehydes and sulfur-containing compounds, alcohols, ketones, phenols, acids and nitrogen-containing compounds, wherein aldehydes (16 species) were mainly pentanal, hexanal, (*E, E*)-2,4-decadienal etc., sulfur-containing compounds (3 species) are dimethyl trisulfide, 2-furfurylthiol and methional. Volatile compounds detected in comparative example 2 and 3 were less than 30. Therefore, DB-Wax extraction method of volatile compounds in meat or meat product of the present invention was more effective than HP-5MS extraction method ($p < 0.05$), and volatile compounds can be better separated by the heating process in the embodiment.

30 [00080] (2) Comparative analysis of thermal image of odor activity values and

thermal image of contribution rate

[00081] Thermal image of odor activity values of components having a cumulative contribution rate greater than 90% and an odor activity value greater than 1 in volatile compounds of the embodiment (the darker the color, the larger the odor activity value) was shown in Fig.8.

[00082] Thermal image of contribution rate of components having a cumulative contribution rate greater than 90% and a odor activity value greater than 1 in volatile compounds of the embodiment (the darker the color, the larger the contribution rate) was shown in Fig.9.

[00083] Thermal image of odor activity value of components having a cumulative contribution rate greater than 90% and an odor activity value greater than 1 in volatile compounds of the embodiment was shown in Fig.10.

[00084] Comparison results of flavor characteristics and strength of characteristic volatile compounds obtained by the embodiment with those of meat or meat products were shown in Fig. 11.

[00085] As shown in Fig. 8, Fig. 9 and Table 1, there were 18 kinds of components having a cumulative contribution rate greater than 90% and an odor activity value greater than 1 in volatile compounds, including 12 aldehydes, 3 sulfur-containing compounds and 1 alcohols. But it was difficult to find characteristic volatile compounds from Fig. 8. The odor activity value of each component in the volatile compounds was only calculated in the Comparative Example 1. Even if the odor activity value was greater than 1, components of volatile compounds in meat or meat products cannot be further analyzed. This was disadvantage of this method.

[00086] The contribution rate was used to visualize explanation contribution of each component of volatile compounds in meat or meat products. As shown in Fig. 9, the volatile compound in meat or meat products were mainly 2-furfurylthiol and dimethyl trisulfide, followed by methional and (*E,E*)-2,4-decadienal. This demonstrated that the contribution rate method and the cumulative contribution rate method provided by the present invention can identify characteristic volatile compounds more intuitively.

[00087] In order to more accurately determine components of characteristic volatile

compounds in meat or meat products, the embodiment continued to compare different recombination models using a sensory triangular test, as shown in Fig. 10 and 11, components of characteristic volatile compounds in meat or meat products had 9 kinds, including 2-furfurylthiol, dimethyl trisulfide, methional, hexanal, heptanal, 5 octanal, nonanal, (*E,E*)-2,4-decadienal and 1-octen-3-ol. Characteristic flavors of meat or meat products were fatty flavor, roast flavor and meat flavor. Thus, the method provided by the present invention can accurately determine components of characteristic volatile compounds in meat or meat products as well as the characteristic flavors of the characteristic volatile compounds.

10 [00088] Although embodiments of the present invention have been disclosed as above, they are not limited to the applications listed in the Specification and implementation modes. They can be applied to all kinds of fields suitable for the present invention. Additional modifications can be easily implemented for those who are familiar with the field. Therefore, the present invention is not limited to specific details and the 15 legends shown and described herein without deviation from the general concepts confined in the Claim and the Equivalents.

CONCLUSIES

1. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten, omvattende de volgende stappen:

5 -stap 1: het extraheren van vluchtige verbindingen uit vlees of vleesproducten en het detecteren van de concentratie van elke component in de vluchtige verbindingen;

 -stap 2: het berekenen van een geuractiviteitswaarde van elke component, en het verkrijgen van een bijdragesnelheid van elke component volgens
10 een verhouding van de geuractiviteitswaarde van elke component tot de som van de geuractiviteitswaarden van alle componenten;

 -stap 3: het sorteren van de bijdragesnelheid van elke component in aflopende volgorde, het selecteren van M componenten waarvan de cumulatieve bijdragesnelheid groter is dan een vooraf ingestelde waarde a in aflopende volgorde,
15 en dan het selecteren van N componenten waarvan de geuractiviteitswaarde groter is dan een vooraf ingestelde waarde b uit de M componenten met de cumulatieve bijdragesnelheid groter dan de vooraf ingestelde waarde a;

 -stap 4: het bereiden van een reukloze vlees- of vleesproductmatrix, het bereiden van een gemengde standaardoplossing 1 van de N
20 componenten verkregen in stap 3 volgens de concentratie van elke component in stap 1, het toevoegen van de gemengde standaardoplossing 1 aan de geurloze vlees- of vleesproductmatrix om een recombiniatiemodel 1 te vormen, het verwijderen van een van de N componenten verkregen in stap 3, het bereiden van een gemengde standaardoplossing 2 van de resterende componenten volgens de concentratie van elke
25 component in stap 1, het toevoegen van de gemengde standaardoplossing 2 aan de geurloze vlees- of vleesproductmatrix om een recombiniatiemodel 2 te vormen, het vergelijken van de smaak van het recombiniatiemodel 1 met het recombiniatiemodel 2, waarbij de vluchtige verbinding die verschil in geur veroorzaakt de karakteristieke vluchtige verbinding van vlees of vleesproducten is.

30 2. Werkwijze voor het identificeren van karakteristieke vluchtige

verbindingen in vlees of vleesproducten volgens conclusie 1, **met het kenmerk**, dat een inrichting voor het detecteren van vluchtige verbindingen een gaschromatografie-olfactometrie-massaspectrometrie is, waarbij het verhittingsproces van de gaschromatografie-olfactometrie-massaspectrometrie omvat: het houden bij de
5 initiële kolomtemperatuur van T_1 °C, $T_1 \leq 40$, gedurende t_1 min, $t_1 \geq 3$, het verwarmen tot T_2 °C met een snelheid van v_1 °C/min, $60 \leq T_2 \leq 80$, het verwarmen tot T_3 °C met een snelheid van v_2 °C/min, $120 \leq T_3 \leq 140$, en dan het verwarmen tot T_4 °C met een snelheid van v_3 °C/min, $T_4 \geq 230$, het houden gedurende t_2 min, $t_2 \geq 10$, waarbij $v_1 < v_2 < v_3$.

10 3. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 1, **met het kenmerk**, dat als werkwijze voor het extraheren van vluchtige verbindingen in vlees of vleesproducten, een headspace-vastefase-microextractieproces wordt toegepast, waarbij het extractieproces omvat: het wegen van vlees of vleesproduct, het
15 toevoegen van een verzadigde natriumchlorideoplossing aan het vlees of vleesproduct in een verhouding van 1 ml : 1 g, het toevoegen van een organisch standaardverbinding, het gelijkmatig roeren, het voorverwarmen gedurende 8 - 15 min bij 40 - 60 °C, en het adsorberen door middel van een CAR / PDMS-extractienaald bij 40 - 60 °C gedurende 40 - 60 min.

20 4. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 2, **met het kenmerk**, dat het proces van het kwalitatief detecteren van specifieke componenten van vluchtige verbindingen met behulp van de gaschromatografie-olfactometrie-massaspectrometrie omvat: het terugwinnen door middel van een massaspectrometrische bibliotheek, het
25 berekenen van de retentie-index, het analyseren door middel van een olfactometrie, en het uitvoeren van een standaard kwalitatieve analyse om specifieke componenten van vluchtige verbindingen te verkrijgen.

5. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 4, **met het kenmerk**, dat
30 het proces van kwantitatieve detectie van de concentratie van elke component in

vluchtige verbindingen met behulp van de gaschromatografie-olfactometrie-massaspectrometrie omvat: het bereiden van een veelheid van reukloze vlees- of vleesproductmatrices, het detecteren van elke component in vluchtige verbindingen met behulp van de gaschromatografie-olfactometrie-massaspectrometrie, het nemen van een standaardmonster om een gemengde standaardoplossing 3 met verschillende concentratie te bereiden, het toevoegen van de gemengde standaardoplossing 3 met verschillende concentratie aan de veelheid van reukloze vlees- of vleesproductmatrices, het extraheren van vluchtige verbindingen van elk van de vlees- of vleesproductmatrices die de gemengde standaardoplossing 3 bevatten door middel van de headspace-vastefase-microextractieproces, het detecteren van het piekoppervlak van karakteristieke ionfragmenten van elke component door middel van de gaschromatografie-olfactometrie-massaspectrometrie, het opstellen van een standaardcurvenvergelijking tussen het piekoppervlak van karakteristieke ionfragmenten en de concentratie van elke component in vluchtige verbindingen, en het bepalen van de concentratie van elke component in vluchtige verbindingen van vlees of vleesproducten volgens het piekoppervlak van karakteristieke ionfragmenten van elke component in vluchtige verbindingen van vlees of vleesproducten gedetecteerd door de gaschromatografie-olfactometrie-massaspectrometrie.

6. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 1 of 5, **met het kenmerk**, dat een werkwijze voor het bereiden van reukloze vlees- of vleesproductmatrices omvat: het wegen van vlees of vleesproduct, het mengen van het vlees of vleesproduct, diethylether en n-pentaaan in een verhouding van 1 g: 2 ml: 1 ml, het schudden van het daaruit resulterende mengsel in een schudinrichting, het filteren, het verwijderen van organische oplossing, het meerdere keren herhalen van de bewerking totdat het vlees of vleesproduct reukloos is, het invriezen en drogen van het reukloze vlees of vleesproduct, en het daaraan toevoegen van gezuiverd water, waarbij de hoeveelheid toegevoegd gezuiverd water consistent is met het watergehalte van het vlees of vleesproduct.

7. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 1, **met het kenmerk**, dat als werkwijze voor het vergelijken van de smaak van het recombatiemodel 1 met het recombatiemodel 2, de sensorische analyse-driehoekstest wordt gebruikt.

5 8. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 1, **met het kenmerk**, dat de vooraf ingestelde waarde a 90% is en de vooraf ingestelde waarde b 1 is.

9. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 2, **met het kenmerk**, dat de capillaire kolom van de gaschromatografie-olfactometrie-massaspectrometrie DB-Wax is en het verhittingsproces omvat: het houden bij de initiële kolomtemperatuur van 40 °C gedurende 3 min, het verwarmen tot 70 °C met een snelheid van 2 °C / min, het verwarmen tot 130 °C met een snelheid van 3 °C / min, het verwarmen tot 230 °C met een snelheid van 10 °C / min, en het houden gedurende
10 15 10 min.

10. Werkwijze voor het identificeren van karakteristieke vluchtige verbindingen in vlees of vleesproducten volgens conclusie 3, **met het kenmerk**, dat het proces voor het extraheren van vluchtige verbindingen uit vlees of vleesproducten omvat: het wegen van vlees of vleesproduct, het toevoegen van een verzadigde natriumchlorideoplossing aan het vlees of vleesproduct in een verhouding van 1 ml : 1
20 g, het toevoegen van een standaardmonster van 2-methyl-3-heptanon, het plaatsen van een magnetische rotor om magnetisch roeren uit te voeren, het gelijkmatig roeren, het voorverwarmen gedurende 10 min bij 55 °C, en het adsorberen door middel van een 75 µm CAR / PDMS-extractienaald bij 55 °C gedurende 45 min.

25

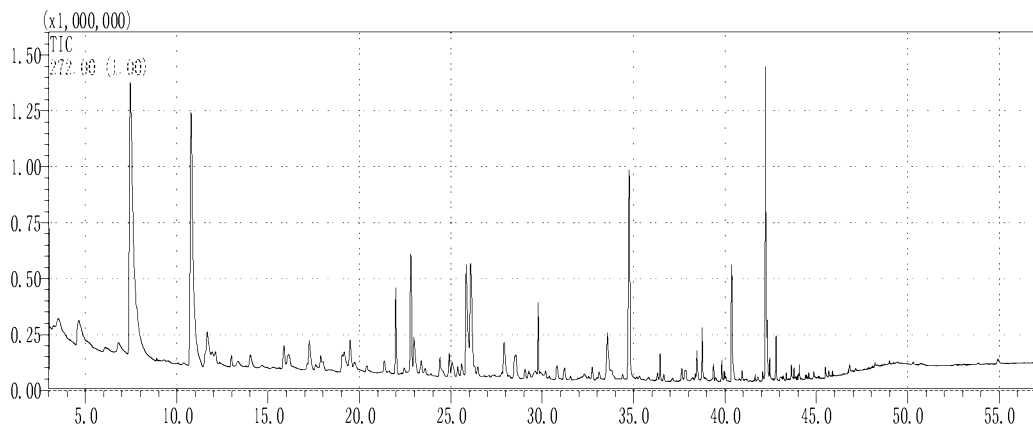


Fig.1

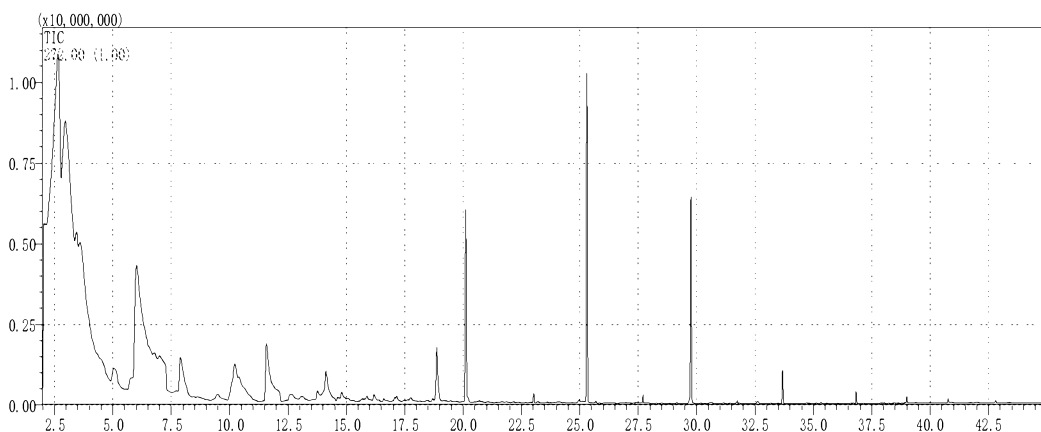


Fig.2

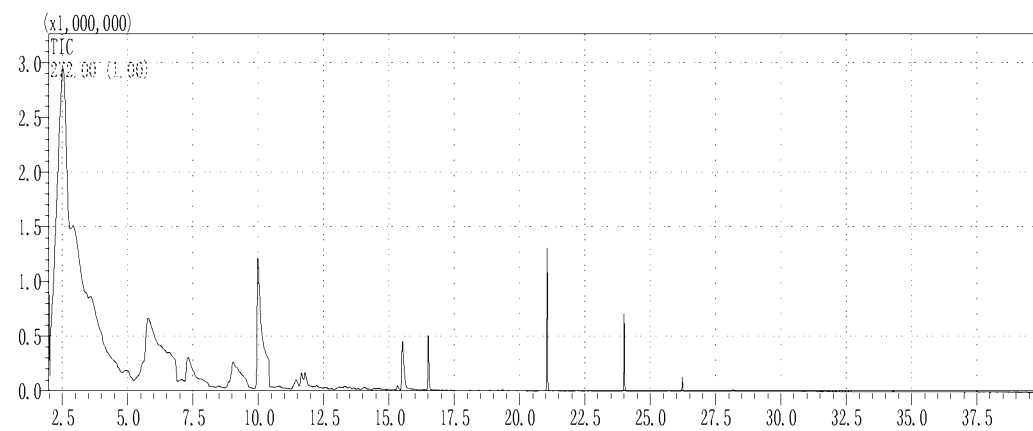


Fig.3

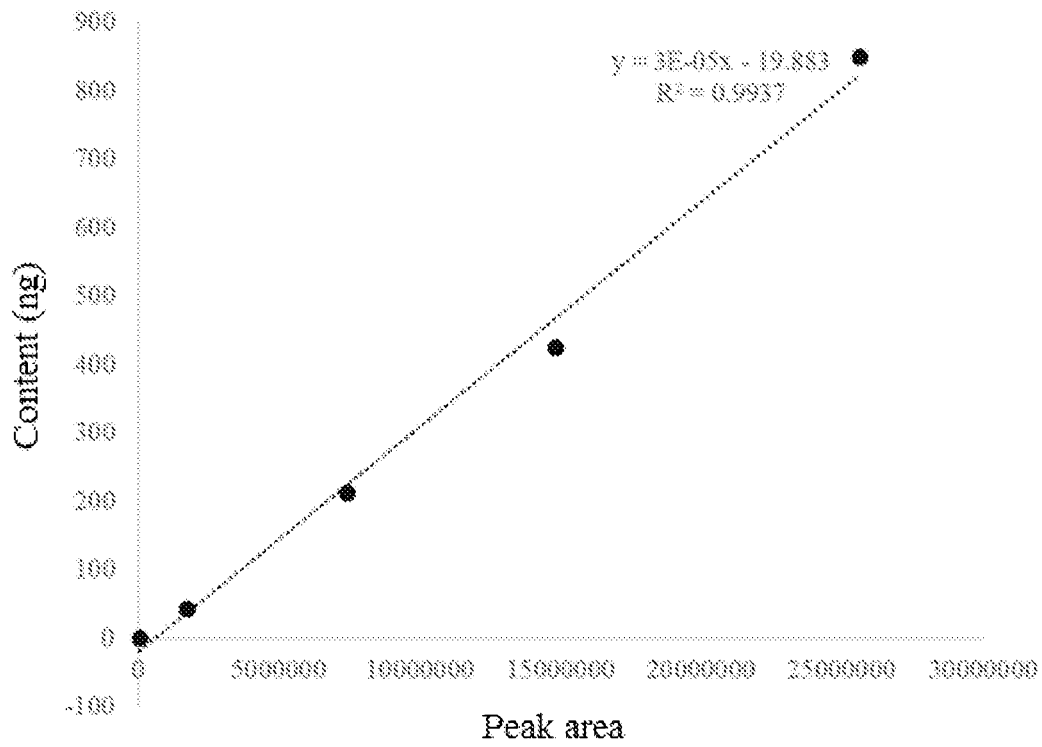


Fig.4

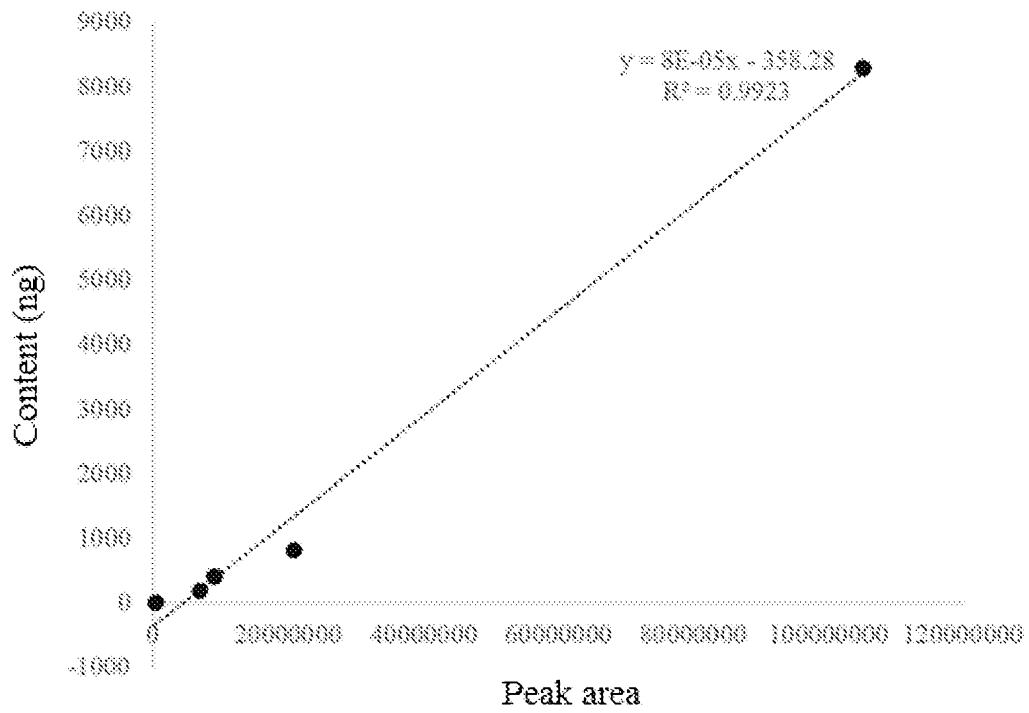


Fig.5

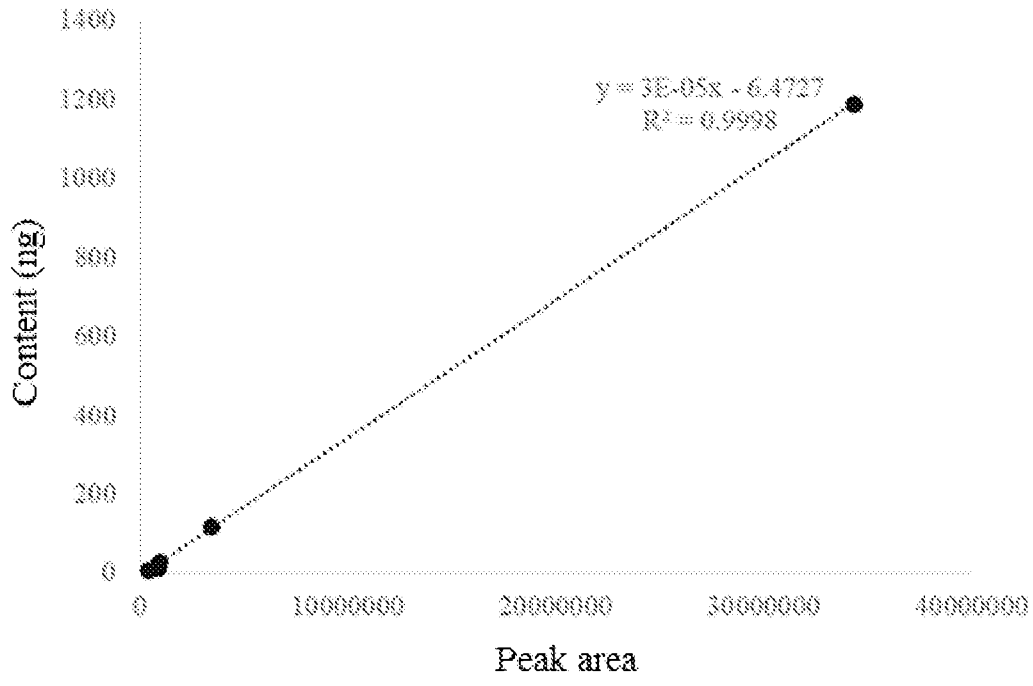


Fig.6

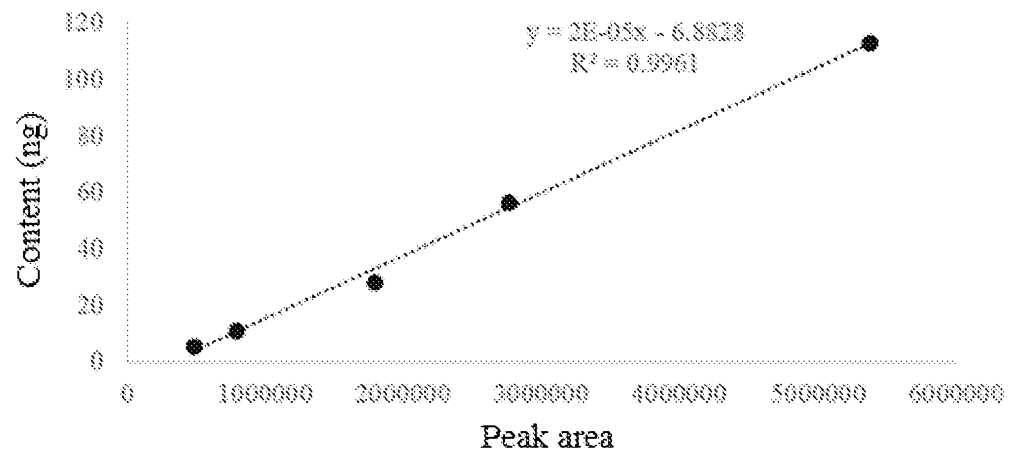


Fig.7

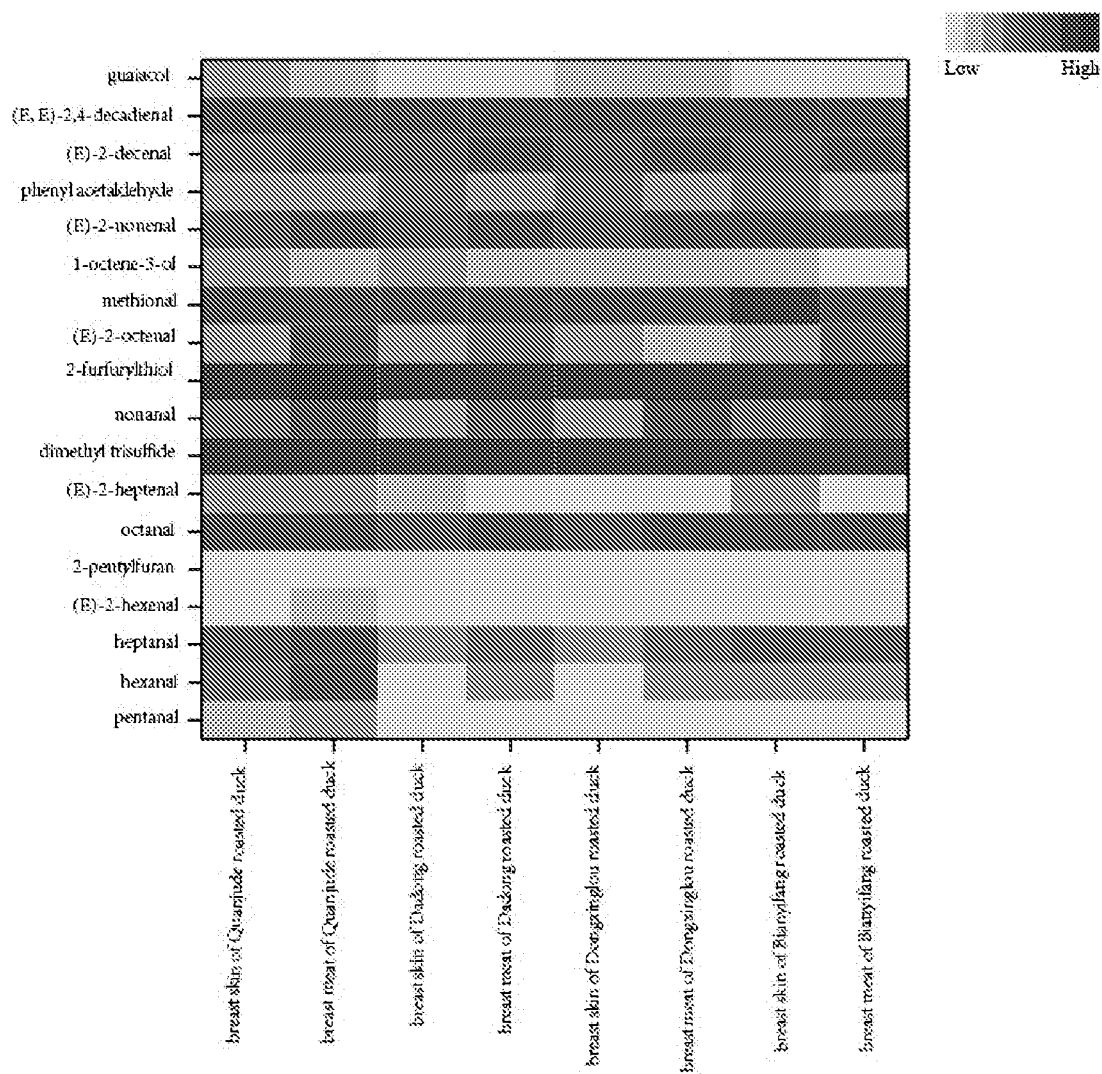


Fig.8

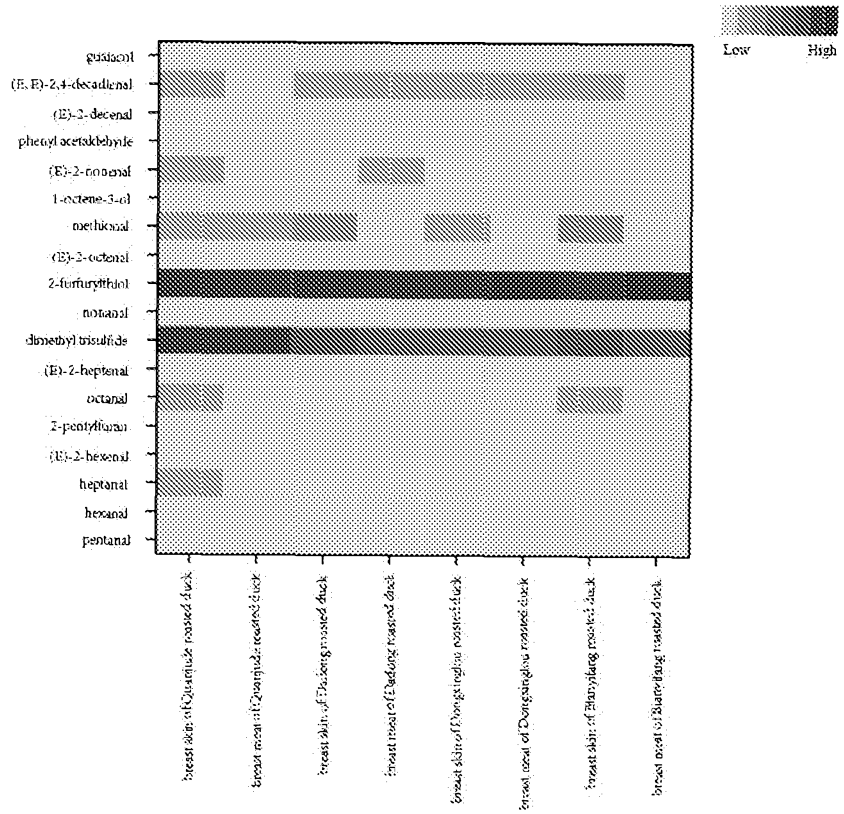


Fig.9

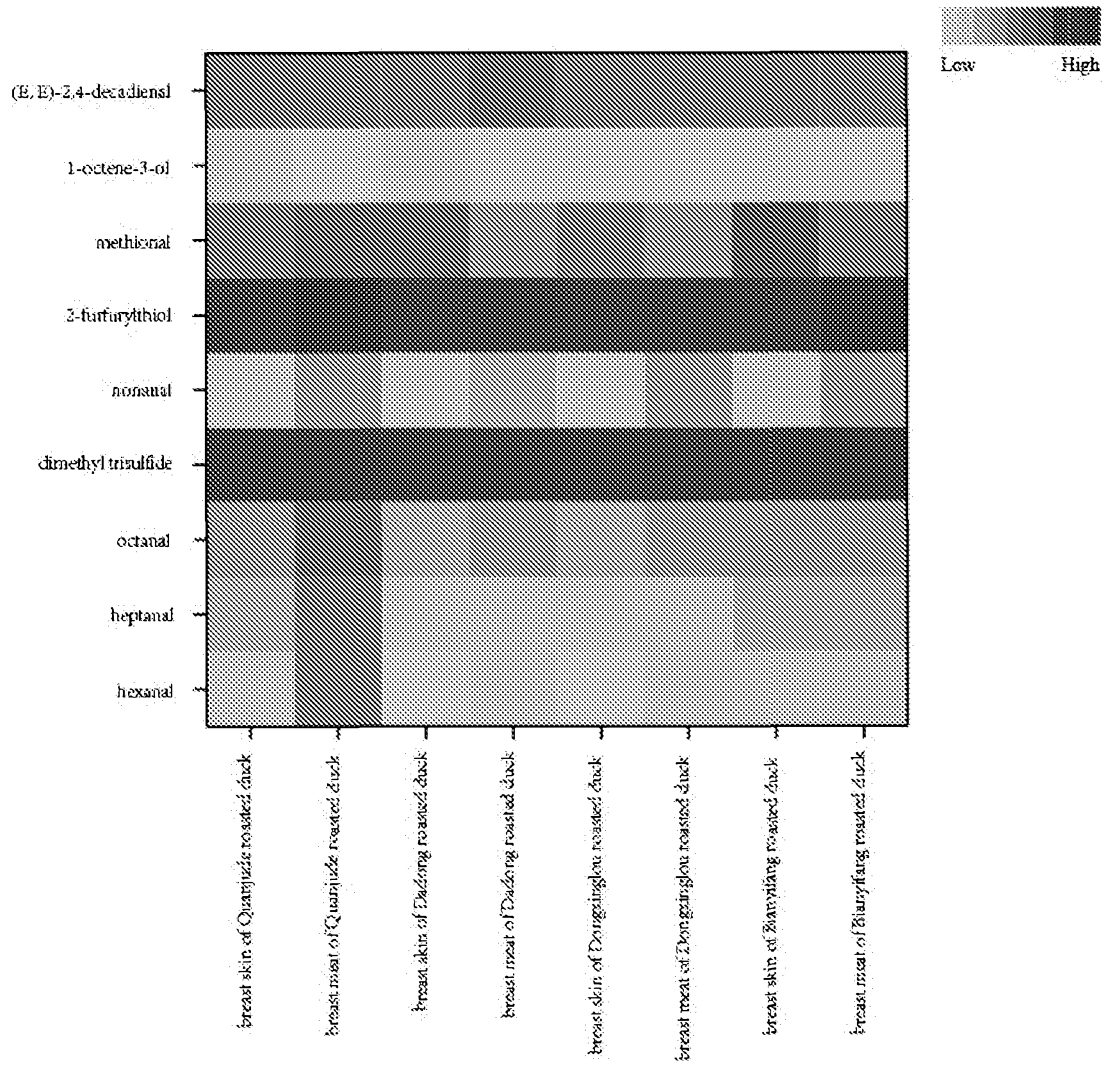


Fig.10

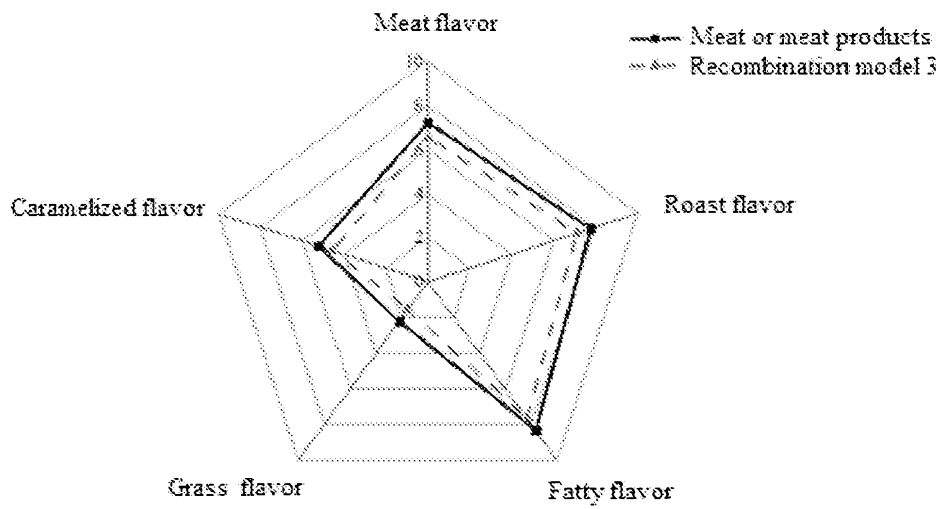


Fig.11

ABSTRACT

The present invention discloses a identification method of characteristic volatile compounds in meat or meat products, including: extracting volatile compounds from
5 meat or meat products and detecting each component concentration; calculating odor activity value and contribution rate of each component; selecting N components whose cumulative contribution rate and odor activity value is respectively greater than preset value a and b; preparing a recombination model 1 of N components standard sample and odorless meat or meat products material, deleting one of N components,
10 and preparing a recombination model 2 with odorless meat or meat products materials, comparing flavor of recombination model 1 with 2, wherein component caused difference in flavor is characteristic volatile compound of meat or meat products. The present invention can avoid inaccurate drawback of traditional method by single gas chromatography-olfactometry-mass spectrometry, and can accurately and quickly
15 identify volatile compounds of meat or meat products,