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THE RESEARCH FOR THE FORMING MECHANISM ON COLOUR ,FLAVOUR AND TASTE MATTERS OF JINHUA HAM

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ABSTRACT:This article consists of three parts: The first part describes the absorption spectra of Jinhua Ham muscles during various processing periods. Thus the pigments in fresh muscle,picked muscle, fermented muscle and muscle of finished ham were determined on basis of the spectrum analysis. The second part explains that the volatile flavour components were separated from Jinhua Ham by steam ditillation.The distillate was extracted by ether, then concentrated by volatilizing of the ether. 48 components were isolated and identified from the concentrate by GC-MS. Most of them from Jinhua Ham for the first time. The third part, the complex taste system of Jinhua Ham includes palatable taste which is the main taste. The main palatable compound in the ham is glutamic acid.

Key Words: Ham, Colour, Pigments, Flavour, Taste.

Foreword: Jinhua Ham is a special, famous traditional meat product with more than eight hundred years' history. It has bright colour, strong flavour, palatable taste, beautiful appearance and long storage period, so it has gained fame worldwide.

To improve the quality of Jinhua Ham, we carried out a systematic study about the relations of colour, flavour, taste, moulds and different processing conditions with it. After tracing the processes--raw materials, picking, washing and sunning, fermenting, finished ham, we have studied the gradual forming process of the Ham's flavour and taste, and the relations between moulds and flavour. We also studied the relations of different amount of salts, different pickling and fermenting conditions, and whether nitrate is applied etc. with the Ham's colour, colour, flavour, taste and its grade.

After several years' endeavour,we have learned the components of Jinhua Ham's colour, flavour and the taste, and their forming theory, now the results of the research is stated as follows:

1 Jinhua Ham's Colour

The red colour of animal's muscle is mainly composed of myoglobin(70-80%) in muscle cell and hemoglobin(20-30%) in micro blood vessels. After animal is bloodletting, the colour is from myoglobin which is 90% of the body muscle. Though cell pigment and catalase etc., also contain heme, their quantity is small. The colour of matters is from their absorption of lights with certain wavelengths in visible light area. Seen from myoglobin absorption spectrum of visible light, there is a wide absorption peak between 550nm and 575nm. So myoglobin appears to be dark purplish red. When muscle is cut open, myoglobin reacts with oxygen and becomes oxymyoglobin. In oxymyoglobin, auxiliary radical of ferroheme combines with one molecule of oxygen in form of aux-bond its ferrous atom still remains to be +2 valence. In the visible light absorption spectrum of oxymyoglobin, there are two absorption peaks,one at 545nm, the other at 580nm, and a clear valley at 562nm. So oxymyoglobin appears to be bright red.

When muscle is heated or stored for a long time, myoglobin can be oxidized to metmyoglobin,The original +2 valence ferrous ion in auxiliary radical of ferroheme is oxidized to +3 valence ferric ion. Ferroheme becomes metheme. In the visible light absorption spectrum of ferric metmyoglobin, there is an absorption peak at 505nm. There is a weak absorption peak at 627nm. The absorption spectrum of myoglobin, oxymyoglobin and ferric metmyoglobin is shown in Fig. 1. myoglobin can react with NO to form nitrosomyoglobin. The characteric absorption peak of nitrosomyoglobin is located at 578nm(more strong). So nitrosomyoglobin appears to be bright pink. Nitrate or nitrite is not applied in Jinhua Ham's processing.

Colour surveying instruments are mainly divided into two kinds: colorimeter and spectrophotometer. The former can directly survey the colour stimulating value of object and colour coordinate. The latter surveys the reflectance or transmissivity of objects to tights of different wavelengths, instead of the colours and get the colour stimulating value of samples and colour

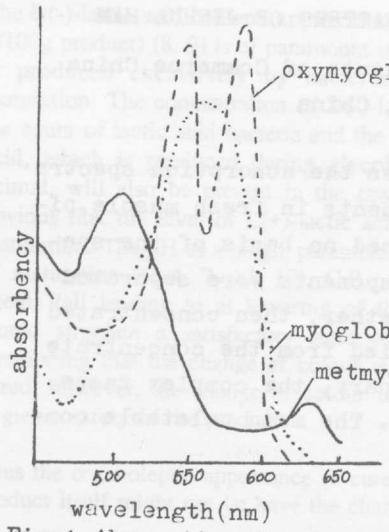

Fig.1 Absorption Spectrum of Myoglobin Oxymyoglobin and Metmyo.

coordinate by calculation. It is more important to infer what has formed the colour by analyzing the absorption spectrum of samples.

When spectrophotometer is used to survey muscle colour, solvents are generally used to draw pigments from the muscle. Then the absorption spectrum of pigments is surveyed during the transmission. Someone suggests that acetone aqueous solution and acetone salt solution be used to draw pigments from the muscle. But our experiments show, neither of the solvents can draw all pigments in Jinhua Ham. We think that the method of surveying transmissive absorption spectrum of pigments drawn by solvents can neither ensure that pigments are all drawn or evenly drawn, nor prevent pigments from changing and reacting with solvents in the process, So we use spectrophotometer to direct survey absorption spectrum of samples when reflecting visible light. The method is simple, but the results is reliable and closer to human observation.

For Jinhua Ham made in traditional way, we begin surveying the absorption spectrum from fresh muscle, pickling, fermenting to finished hams. For Jinhua Ham products made by new technology, we have also surveyed.

1-1 Materials and Methods

1-2.1 Tested Materials

Fresh haunch is bought from the market. Other samples are supplied by Dongyang Ham Factory. Sampling Dates, Processing Methods, Processing Periods and Sampling Places are shown in Tab.1.

Tab.1 Sampling Dates, Processing Periods and Sampling Places

sample No	sampling date	processing method	processing periods	sampling place
1			fresh muscle	lnner muscle
2			fresh muscle	outer muscle
3	March 22	tradition-al tech.	picking finished	inner muscle
4	March 22	tradition-al tech.	picking finished	outer muscle
5	June 1	tradition-al tech.	middle of fermenting	inner muscle
6	October 8	tradition-al tech.	finished ham	inner muscle
7	October 8	new tech.	finished ham	inner muscle

1-2.2 Testing Instrument

U V 240, 2-Route Ultraviolet Spectrphotometer. Testing condition o/d, white working standard: Magnesium Oxidize.

2 Jinhua Ham's Flavour

Researchs about Jinhua Ham's Flavour are very less. Someone did separation identification of volatile matters in the ham; but can not separate the ones whose boiling points are lower than hexane as he used hexane as solvent. In our research, we first use steam distillation method to draw volatile matters from Jinhua Ham, then extract them with ether and concentrate them, at last separate and identify them with chromatograph and mass spectrograph.

2-1 Treating of Samples

The samples are from superfine Jinhua Ham supplied by Dongyang Ham Factory. We choose the middle part of the ham, remove skin, bones and fat, obtain 100g ham muscle of pure flavour, then mince it to grains and change it to 400ml liquid by steam distillation. Nacl is used to saturate it and 50ml rerun ether is used 3 times to extrate it. The ether layer is dried by anhydrous Na_2SO_4. After filtration, it volatilizes to about 0.1ml. The sample is dark brown liquid with Jinhua Ham 's Flavour.

2-2 Instruments

Varian 3400-Finnigan MAT 8230/ss 300/DS chromatograph and mass spectrograph with computer index date base.

2-3 Chromatograph Conditions

chromatograph Column:DB-5,0.2mmID 30m, carrier gas:He, Branching Ratio:1:10, Incoming Temperature:260°C, separating temperature:Incoming Quantity:0.1μl, Column Temperature:40°C $\xrightarrow{10\text{min}}$ 40°C $\xrightarrow{4°\text{C/min}}$ 80°C $\xrightarrow{6°\text{C min}}$ 250°C

2-4 Mass Spectra Conditions

Ionizing Pattem:EI, Electronic Energy:70 eV, Emitting Electric Current:1 mA, Resolution R=1000, Scanning Range:m/e 300-400, Scanning Speed:1 s/10 time range, Scanning Interval:0.3 S.

2-5 Result (see Tab.2)

3 Taste of Jinhua Ham

The taste of Jinhua Ham is a complicated, abundant and comprehensive tasting system with palatable taste as main part, including salty, bitter, sour and sweet ect. According to present studies of palatable taste, we know that main palatable matters in foods are nucletide, amino acid, organic acids etc. Main palatable ingredients in fresh meat are 5'-IMP. Now there are short of researchs about main palatable matters, delicating conditions and other testing matters of Jinhua Ham. We have identified tasting matters of palatable taste and other key tastes, as well as tasting conditions.

3-1 Materials and Methods

3-1.1 Testing Materials and Contents

We have traced and tested PH value and contents of water, NaCl, all kinds of free amino acids, during the whole processing of Jinhua Ham from fresh muscle, salting and fermenting processes to finished ham. We have tested organic acid, general titrating acid and volatile acid of fresh muscle and finished ham. We have also tested inosine monophosphate of the finished ham.

Fresh meat was bought from market. Other samples were all supplied by Dongyang Ham Factory Sampling places were inner muscle.

Tab. 2 Chemical Compounds in valatable Matters of Jinhua Ham

Categories	Identified Chemical Compounds	Identified at first time
Alkanes	octane,decane,octodecyl,hexadecane,dodecane,tetradecyl,pentadecyl,heptadecane,nondecoic,sane eicosane,2.6.10-trimethyl hexadecane	✓
Alcohols	benzol ethanol,cyclo-heptadecane alcohol	✓
Aldehydes	acetaldehyde methoxy,acetaldehude,2-methyl butyl-aldenhyde, 3-methyl butyl-aldehyde,benzol-carboxaldehyde,benzol-aldehyde, hexadeca-aldehyde,tridecaaldehyde	✓
Ketones	1-acetyloxide-2-butanone,1-7.7-tricarbdicycle(2.2.1)oenanthyl-2-ketone,1.5-dicyclicete-3.3-dimethyl dicyclietane,(3.1.0)-hexane-2-ketone	✓
Alkenes	1-(1-acetyloxide)-3-hexene	✓
Acids	acetic acid,propyl acetic acid. tetradeca acid,hexadeca acid	✓
Esters	acetic acid ethyl ester,acetic acid-2-ethyl ester,butanoic acid,ethyl ester,3-hydroxy-butyric acid ester,acetic acid-1-propanol ester,methyl-sulfocyanate,butyl diacid diethyl ester, benzoic acid isopropyl ester	✓
Acyl amines	N-ethyl butytic acid amide, N-benzene carbon amide	✓
Sulfur alco.	propyl ketene sulfhydrate	✓

3-2 Testing Methods

3-2.1 Determination of Moisture Content

Drying Method at atmospheric pressure is adopted.

3-2.2 Determination of NaCl content

Standard $AgNO_3$ solution titrating method is used after NaCl is soaked out.

3-2.3 Determination of

PH

Digital PH meter is used.

3-2.4 Determination of total titrating acid content standard NaOH solution is used to titrate the acid to PH=9.0 after it is soaked out. Total titrating acid content is counted by lactic acid.

3-2.5 Determination of volatile acid content

Direct method is used, volatile acid content is counted by acetic acid.

3-2.6 Determination of organic acid content

Thin layer separating method is adopted.

3-2.7 Determination of free amino acid and IMP

Free amino acid content is determination by amino acid analyser. IMP content is determination by high pressure liquid chromatograph.

3-2.8 Testing Results

Taste of the ham comes mainly from amino acid, especially from glutamic acid. Tracing determination shows that glutamic acid and other amino acids increase sigificantly with the extension of the Ham's processing. The content of glutamic acid in finished ham is 18 times of its threshold. Increase of amino acids is the result that enzyme resolves proteins in haunch under proper temperature and humidity PH value of the Ham is about 6, under which condition glutamic acid is more palatable.

Content of amino acids at every processing period is shown in Tab.3.

4 Discussion

4-1 The relations between the formation Jinhua Ham's colour, flavour and taste and moulds. The formation of Jinhua Ham's colour, flavour and taste has no direct relations with moulds appearing on the surface during fermenting period,we have analysed muscle and fat of hams made by natural fermenting and new technology, and found that unmouldy ham has more nutritive ingredients and less oxidized fat and rejests. There is no great difference of amino acids between mouldy ham and unmouldy one. Moulds do not have direct, but have indirect relations to the formation of Jinhua Ham's colour, flavour and taste, as growth of moulds depresses growth of decay bacteria and assures the formation of Jinhua Ham's colour, flavour and taste under traditional processing.

Tab.3 Total Amino Acid Content and Glutamic Acid Content of Inner Muscle of Fresh Muscle and Jinhua Ham at every Processing Period

processing period	Jinhua Ham(traditional processing technology)		Jinhua Ham(new technology)	
	total amino acids cont.	glutamic acid	total amino acids cont.	glutamic acid
fresh muscle	0.753	0.018	0.753	0.018
pickling finished	1.281	0.143	1.638	0.275
initial fermenting stage	2.25	0.19	2.73	0.3
middle fermenting stage	4.951	0.550		
later fermenting stage	7.025	0.907		
finished ham	11.454	1.112	9.042	1.246

4-2 About carcinogen in the Ham It is thought that there are more nitrite and maybe some aflayoxin in the ham, both of which are carcinogen.But we belive: A. Nitrite content of National Standard in ham is below 20 ppm. It is much lower than that of advanced countries. We have determined nitrite content in Jinhua Ham to be less than 4 ppm, which has no ham to human health. B. Though is aflatoxin in outside of the ham, no aflatoxin β-a carcinogen exists in the inner muscle.

4-3 Fresh meat materials are the base to assure Jinhua Ham's colour, flavour and taste, salt quantity, number of applying salt, places, washing and sunning are the key to prevent decay in fermenting period. Activity of emzyme increases rapidly when temperature rises in fermenting period. It is critical for Jinhua Ham to have palatable flavour and taste.