Research on Goose Meat and its Product Development

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SUMMARY: On the basis of the modern analitical means, determining microstructure and components of goose meat, the result indicates that goose myofibrilas are thinner, scarcomere is shorter, the meat is tender, its proteins are of high quality and complete one. Goose fat is rich in unsaturated fatty acids that are much better than that of the other's. The nutritional value of the meat is higher, the mashed goose bone contains a great deal of protein and minerals as well as trace elements. It can be used as an ideal nutrient enhancer.

The optimum proportion of de-fishyness agent which is composed of β－cyclodextrin and the other ingredients is obtained by means of Scheffe statistics. The quality booster which can promote water holding capacity of goose meat is chosen and formulated by using the orthogonal test. As result, high quality goose meat products have been developed, such as goose brine ham, mashed goose bone sausage and goose meat sausage.

INTRODUCTION: With a vast expanse of land and in abundant natural resouces, China is provided with many natural conditions in goose breeding. Chinese farmers have been breeding geese for ages with professional experience. Goose breeding, which is a good way in getting rid of poverty and getting rich, is popular because of its short breeding circle with higher profit and easer management. At the present, the nation has the largest numbers of goose in the world with rapid increasing of the production.

For a long time past, the improving of nutritional level of the Chinese has fallen behind the economic development rate in china. Protein intaking per capita is insufficient especially in complete proteins. The majority of the Chinese comsume pork as their major source of meat supply, while in China per head only possesses grains less than 400 kilograms per year. This situation makes it impossible for the nation to put more grains into the grain-to-meat conversion process in reconstruction of the Chinese food intaking structure. To solve this problem, the policy aimes at the development of grain-saving livestock and poultry programs, so as to promote meat supply situation and improve Chinese nutritional status.

Because of the consumer's food habits and, whatever reasons, little has been done about goose breeding in the nation, neither on theoretical study nor on its development and utilization, the consumers in the north refuse to consume goose and its products because of its fishy taste and rough fibre.

This study is carried out in attempting to deal with such considerations so as to meet the need of improving Chinese food intaking structure and finding a new protein source.

MATERIALS AND METHODS: 1. Materials: Moulted goose, freezed carved pork, β－cyclodextrin (β－CD), polyphosphatades, spice, isolated soya protein(I.S.P), carragheenin.

2. Equipments and Instruments: Gas-chromatograph (Shimadzu GC-9A), Electron microscope(Japan. Ele. Co. Ldt JEM－1200), Amino Acids Analyser(Hitachi 835－50), Atomic Absorption spectrophotometry (Shimadza AA－670) and conventional instruments, small-style meat processing equipments.

3. Procedures:

(1)Micro-structures of goose, pork and beef. Take goose chest that is butchered at latest as possible and longest back muscle fibres of pork and beef, then put them separately in 2.5% Pentane dialdehyde solution immediatly, fix the samples in 1% O_5O_4 solution and wash, dewater, embed, cut them into sections, and dye the samples step by step, observe structures of the samples under transmission electronlens.

Get goose chest, pork and beef again, soak them in the mixted solution of 0.1% triphosphate sodium and 2.5% sodium chloride for 24 hours with a water bath at 80℃±1 for 30 minutes and treat them as the same procedure that is stated above.

(2)Determination on Components of goose meat

a. Determine proteins, amino acids in chest, leg and buttock of geese. Weigh 20 grams the samples which must be dried to constant accurately, then place them into hydrolizing tubes, add 6N HCl, vacuum and seal the tubes, hydrolize the samples for 24 hours in a drying oven with the temperature at 110℃ and determine the hydrolized samples by the amino acids analyser.

b. Determination on goose fatty acids

Employ Gas-chromatography to determine.

c. Determination on goose bone paste

Use the Chinese Standard Determining Means (GB) to determine conventional components, use Graphite Oven Atomic absorption method to determine trace elements.

(3)Removement of goose fishyness:

Undesirable fishy taste in geese is the main reason consumers reject to the meat. It is a significant block in goose consumption, the fishyness removement is the most vital project in its utilization.

In the experiments, add β－CD, white pepper and cardamom as the agents for removing fishyness. Use 3 different concentrated agents in treatment of the samples, thus get treated samples A_1, A_2, A_3, and group the 3 treated samples as $(A_1A_2), (A_2A_3), (A_1A_3)$. By employing Scheffe statistics to select 12 persons (who are most sensitive) to smell and taste so as to determine the fishyness of treated samples. Each person determines the samples in order $A_1 \rightarrow A_2, A_2 \rightarrow A_1, A_1 \rightarrow A_3, A_3 \rightarrow A_1, A_2 \rightarrow A_3$ $A_3 \rightarrow A_2$ and value the fishyness degree according to the given standards:

＋2: smell and taste of the former sample is much better than those of the latter's.

＋1: smell and taste of the former sample is a little better than those of the latter's.

0: smell and taste of the former sample is equal to those of the latter's.

－1: smell and taste of the former sample is a little worse than those of the latter's.

－2: smell and taste of the former sample is much worse than the those of the latter's.

(4)Water holding Capacity

Determing the value of isolated water and isolated oil, using the heating centrifuging method.

(5)Quality Booster Selection

The Quality standard is the WHC of the booster.

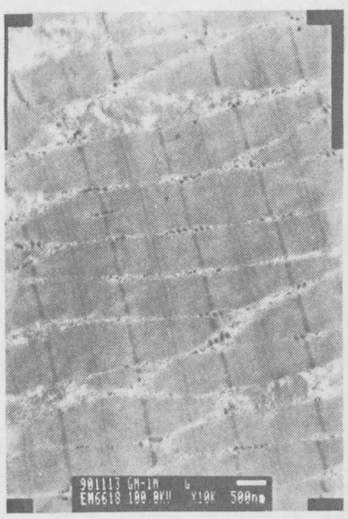
Use 3 different proporation's co-phosphates organize the $L_9(3^4)$ orthogonal test with carrageenin, ISP. co-phosphates and caseinum as 4 factors, use a blank as the standard.

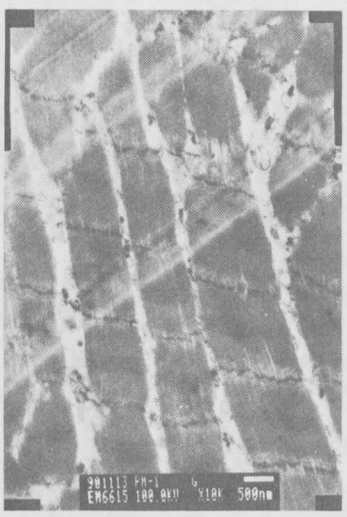
(6)Preparation of goose products.

On the basis of the characteristics of geese, choose β-CD and some additives in removing goose fishyness, employ polyphosphates ISP in improving the WHC, and use papaya proteinase in tendering aging goose. To meet the marketing supply and consumer's demand, we have produced goose brine ham, brine sausage and the bone paste sausage etc.

RESULTS AND DISCUSSION

1. Comparison micro-structure of goose, beef, pork.





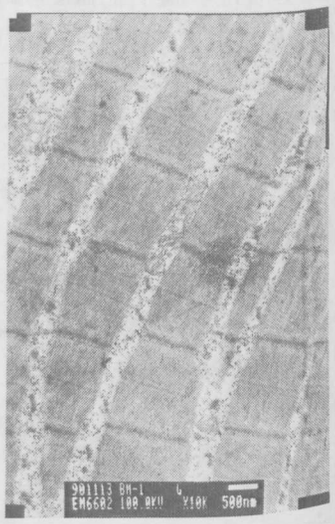
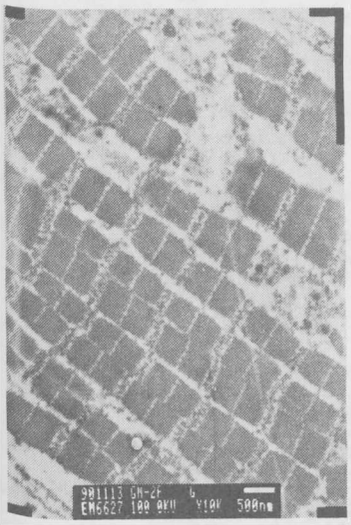


figure 1: picture on goose chest muscle by transmission electronlens enlarged 10,000 times

figure 2: picture on the longest of pig back muscle by transmission electrolens enlarged 10,000 times

figure 3: picture on the longest of cow back muscle by transmission electronlens enlarged 10,000 times

From the above figures we can see goose myofibrillas are obviously thinner and closer than those of pork and beef. The intervals among goose myofbrillas are narrow, scarcomeres of goose are shorter than those of pork which are shorter than those of beef's. The heated myofibrilla has been shrinked, the joints have been recoiled and split along the ends of Z axis, myofibrilla of goose has been shrinked a little, (figure 4), water hoding capacity is lower (figure 5).



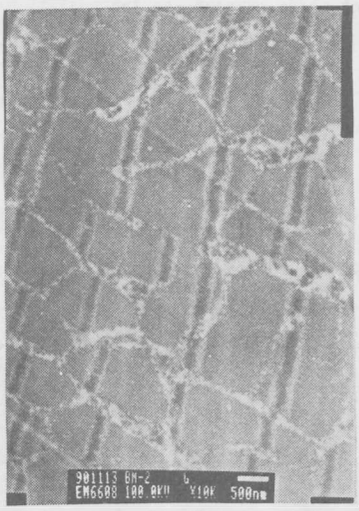


figure 4: the transmission electronlens picture on treated goose meat.

figure 5: the transmission electronlens picture on treated beef.

figure 6: the transmission electronlens picture on treated pork.

Since a little tilted cutting, the picture are not very clear, anyway, the myofibrilla is recoiled thoroughly. Turn to figure 6, even though, myofibrilla is shrinked among vertical fibres connected one another. By using determining sensitive method among the 3 different animal meats, goose meat is the tenderest, followed by that of pork and beef. Since goose with

Table 2—1 Components of Amino Acids in Goose protein. Unit : gram／100 gram sample

portions / Amino Acids	leg	buttock	chest
protein	79.05	85.75	85.98
Aspartic acid	7.891	7.974	8.603
Thereonine	3.573	3.684	3.915
Serine	3.436	3.456	3.356
Glutamic Acid	14.336	16.312	15.554
Prroline	2.825	3.897	3.247
Glycine	3.607	5.345	3.869
Alanine	4.730	5.348	5.298
Cysteine	0.663	0.757	0.714
Valine	4.068	4.178	4.505
Methionone	2.086	2.371	2.317
Lsoleucine	3.473	3.273	3.765
Leucine	6.766	7.050	7.485
Lyrosine	1.903	2.145	1.894
Lysine	6.981	6.354	7.570
Ammonia	0.743	1.137	0.892
Histidine	2.024	2.177	2.302
Phenglalanine	3.369	3.395	3.661
Arginine	4.891	5.270	5.385
Tryptophan	1.501	1.609	1.628

shorter muscle joints and thinner myofibrilla, its meat is the tenderest. The weakness of the goose meat is a lower water holding capacity.

2. Determination on goose components

(1)Analysis of proteins, amino acids in chest, leg and button of geese.

There are over 20 amino acids for human body needs. Evaluating the quality of protein depends on the containing of essential amino acids in food, the closer the ratio among essential amino acids in food, the better.

Table 2—1 Shows the contents of amino asids in geese.

Tables 2—2, 2—3 show that comparison of components of amino acids in geese and those in certain foods as well as those of the recommended allowance for adults.

Table 2—2, Components of essential amino acids in some foods(g／100g raw protein)

meats / A. A	beef	pork	motton	chest flesh of goose	buttock of goose	leg of goose	Chiecllen	egg (whole)
Histidine	2.9	3.2	2.7	2.68	2.54	2.56	3.39	
Lsoleucine	5.3	4.9	4.8	4.38	3.82	4.39	4.06	5.4
Leucine	8.2	7.5	7.4	8.70	8.23	8.56	7.7	8.6
Lysine	8.7	7.8	7.6	8.8	7.42	8.83	9.33	7.0
Wethionine	2.3	2.5	2.3	2.69	2.77	2.64	1.16	3.41
Phenylalanine	4.0	4.1	3.9	4.26	3.96	4.26	2.73	5.63
Threonine	4.3	5.1	4.9	4.56	4.30	4.52	4.81	4.7
Valine	5.5	5.0	5.0	5.24	4.88	5.15	5.02	6.6
Tryptophan	1.2	1.4	1.3	1.89	1.88	1.90	3.73	1.7

Table 2—3 Requirement of essential A. A for adults(mg／day)

A.A	isoleucine	leucine	lysine	methinine	phenylalac	threonine	tryptopha	Valine
Requiment	550	727	544	700	258	375	168	375
Score	3.3	4.3	3.3	4.2	1.6	2.2	1.0	2.2

According to above data, geese have similar contents as other animal meats and better than those of chicken, and rich in amino acids particularly in essential amino acids. The contents of essential amino acids in goose almost meet with the requirement of those given by Hegsted. That is to say, goose proteins are of high quality and complete proteins.

(2)Determination on components of fatty acids in geese.

In terms of chemical structures, divide fatty acids into two parts, saturated fatty acids and unsaturated fatty acids. According to some research reports, certain saturated fatty acids can increase the hyperhipidaemias and cardiovascular, however, certain unsaturated fatty acids can decrease plasma lipidaemias. Some unsaturated acids, which can not be synthesized in human body, are as essential fatty acids in human body. They are supplied by intaking food. Linoleic acid (C 18 : 2) is one of the most important essential fatty acid. When lack of E. F. A, the body will catch a dermatosis and even result in unpreganancy in female. Mostly fat from animal foods contain more saturated fatty acids, and mostly oil from plant food are rich in unsaturated fatty acids except coconut oil.

Determination on components of fatty acids among $C_{12}—C_{20}$ and certain other fatty acids in belly and inner skin of goose by employing Gas-chromatography has given on table 2—4.

Table 2—4 Components of certain natural fatty acids (%)

fats / fatly acids	palm oil	corn oil	soya oil	beef tallow	pork lard	chicken fat	fat of goose belly	fat of goose innerskin
C 12:0								
14:0				2~8	0.7~1.3	1~2	0.3	0.34
16:0	35~38	8~12	7~11	24~32	25~31	15~24	0	
18:0	3~7	2~5	2.4~6	14~28	11~16	4~6	0	
16:1				6	3~4	7~12	27.10	28.31
18:1	37~50	19~50	22~34	36~50	40~51	33~43	51.00	53.50
18:2	7~11	34~62	50~60	1~5	3~12	14~23	17.10	14.00
18:3			2~10			2~3	3.84	3.345
20:4								
22:1								
20:0							0.30	0.25

(3)Determination on components of bone paste of goose. Table 2—5 shows the determined results on general components.

Table 2—5 Components of bone paste of geese (%) mean value±standard deviation

items	moisture	protein	fat	ash
content	66.18±2.03	16.875±0.21	5.1±0.3	12.08±1.37

Table 2—6 shows the determined results on minerals and trace elements in bone paste. unit: %. ppm

elements	Ca	P	Te	Mg	Mn	Zn	Cu	Pb	As
content	3.32%	2.98%	0.68%	0.21%	3.28 ppm	11.62 ppm	5.868 ppm	0.1007 ppm	0.2108 ppm

Table 2—7 shows the comparison on bone paste and meat of geese (%)

items	cavity bone of goose	meat of goose	cavity bone of chicken	chicken	back bone of pig	pork	back bone of cown	beef
moisture	66.18	77.1	65.5	66.3	66.7	66.2	64.2	64.0
protoin	16.875	10.8	16.6	17.2	12.0	17.5	11.5	18.0
fat	5.1	9.8	14.5	15.8	9.6	15.1	8.0	16.4
ash	12.8	0.8	3.1	0.7	11.0	0.9	15.4	1.0
Ca	3.32	0.013	1.0	0.026	3.1	0.005	5.4	0.004

The data indicate that the main components are protein and ash in bone paste of geese, besides there contain a small amount of fat and a great deal of Ca. Mg. Fe. P. Zn, there are also few elements harmful to health, but they are much lower than those allowed by the food law. The bone paste of geese also contains some other essential nutrients such as phospholipid and phosphoprotein which are necessary for growing body and brain of children. Collagen, chondrine and vitamins are found in the bone paste. The bone paste as an available nutrients source can be fortificated to many food products.

3. Goose fishyness removing.

Employ β—cyclodextrin (β—CD) in removing fishyness of geese, prepare 3 different kinds of concentrate β—CD as A_1, A_2, A_3, by using sensitive analysis to determine fishyness removing ability of 3 diferent β—CD. The table 2—8 shows the result (the culculating process is omitted)

Table 2—8 records of sersitive mark for geese product employing de-fishy agent

	$A_1 \rightarrow A_2$	$A_2 \rightarrow A_1$	$A_1 \rightarrow A_3$	$A_3 \rightarrow A_1$	$A_2 \rightarrow A_3$	$A_3 \rightarrow A_2$
1	−1	+1	−1	+1	0	+1
2	−1	+1	−2	+2	0	0
3	0	0	−2	+2	−1	+2
4	−2	+1	−2	+2	−1	+1
5	−1	+1	−2	+2	−1	+2
6	−1	+2	−1	+2	0	+1
7	−1	+1	−2	+2	−1	+2
8	−1	+1	−2	+2	−2	+2
9	−1	+1	−2	+2	−2	+2
10	−1	0	−1	+2	0	+1
11	0	+1	−2	+2	−2	+2
12	−1	0	−2	+2	−2	+2

A3 is better than A2 and A2 in turn is better than A1.

The table points out that β−CD can be as a agent in fishyness removing. A_1 without β−CD could be with strong fishy taste and smell, A_3, A_2 which cantcoin β−CD can not be found out the fishyness. The question is why β−CD has a capacity in removing fishyness. By analysis the β−CD molecular structure, we would get a answer, the formation of β−CD is a cylinder shape, glucose which are the basic groups of β−CD appearas chair's structures C_1 glucoside bond with C_4, the hydroxies of glucose situate in the two ends and outside of the cylinder, however, oxygen atom of glucoside. situates inside of the middle cylinder. So the outside and the two ends of the molecular are hydrophilic parts, on the other hand, the inside of the cylinder is hydrophobic part (see figure 7).

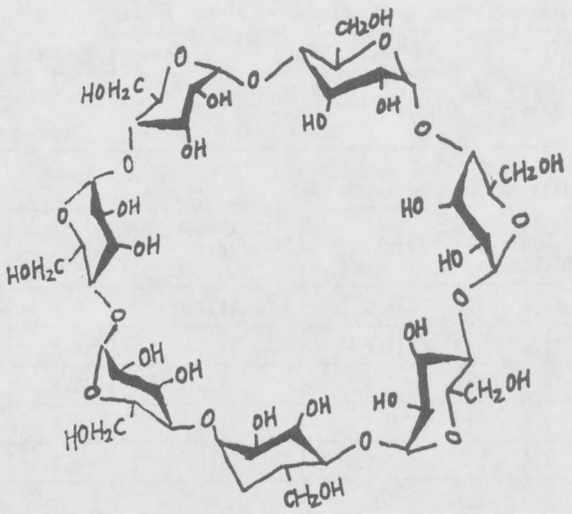


Figure 7 β−CD molecular structure

The fishy smelling of goose is from the evaporating shorter-chain fatty acids as well as some other smaller substances. The effection of β−CD on removing fishyness maybe it has formed complex compounds with fishy substances and are wrapped up inside of the cylinder, so as to conceal the undesirable flavors and taste.

We also employed some spices such as white pepper and cardamon on removing fishyness experiments, the results show that some spices which depend on the strong stimulating smell possess an ability in removing fishyness.

By doing so many experiments, we have decided to combine β−CD and the spices as de-fishy agent, by using Scheffe statistics to abtain the best de-fishyness method.

4. The Determination on Quality Booster in Goose Products

(1)Water Holding Capacity of Polyphosphates

Polyphosphates possess the abibities on increasing WHC in meats and on promoting WHC of salt. That is to say that polyphosphates and salt could contribute their ability together on WHC in meats. The food law in China only allows adding triphosphate sodium, pyrophosphate sodium and hexametaphosphate sodium in meat products, and maximum amount of the additives as 2g/kg, 1g/kg, 1g/kg respectively. Three of them have different ability on WHC. On the basis of $L_9(3^4)$ orthogonal test, the data show that pyrophosphate sodium possesses the best WHC, followed by triphosphate sodium and hexametaphosphate sodium as the last one. the more polyphosphates adding, the better WHC in meat. Based on the WHC, the ratio of 3 kinds of polyphosphates as 1:2:1 is recommended.

(2)Water Holding Capacity of Quality Booster.

According to the experiments, we choose 3 different kinds of concentrate complex phosphates, take isolated soya protein, carrageenin, and casein as 4 factors, to do the research by means of $L_9(3^4)$ orthogonal test.

The result of the research shows: isolated soya protein possesses the best WHC and in turn carrageenin, casein. The three of complex-phosphates have a similar capacity in WHC, the best ratio is a:b:c:d.

5.Research on Processing of Goose Products

(1)Test of goose brine ham

Because of lower fat containning in goose, goose brine ham which is made of pure goose is not a very desirable taste, however, the elasticity and texture of goose brine ham with a deeper color are much better than pork ham, in terms of the goose meat characteristics, we have developed the brine ham with both pork and goose meat. By adding 1% pork lard and some spices, the final product with a pretty light-red color tastes delicious. The tests are also moved to using 3 different kinds of raw meats to produce brine hams by adding pure goose meat, half goose meat and half pork as well as pure pork, the final products are inspected by Scheff sensitive test, the result indicates: under the condition of $\alpha = 0.01$, the quality of mixed brine ham with half goose meat and half pork is almost same with one of pork brine ham, the both hams are better than goose brine ham.

(2)Test of goose meat sausage

The test is done by using 5 samples of products:

a: the product is made of pure goose meat;

b: the product 65% goose meat;

c: the product 50% goose meat;

d: the product 30% goose meat;

e: the product is made of pure pork.

By comparing the products quality to choose the best proportion of goose meat in the products, the result indicate there are without significant differences among 5 products. The result also shows the amount of goose meat adding in the sausage depands on whatever you need.

(3)Test of mashed goose bone sausage

In order to decide the best amount of mashed goose bone adding in sausage, using 0%, 5%, 10%, 15%, 20%, 30%bone paste of total amount of product to put in sausages respectively, employing the pair comparison means to determine the best percentage of adding bone paste. The result shows: adding the bone paste below 20% of total amount of product will not affect the product quality.

CONCLUSIONS

1.Goose myofibrillas is rather thin, sarcomere is quite short, water holding capacity is lower, but the meat is tender.

2.The proteins as high quality proteins contain complete essential amino acids. The fat is rich in unsaturated fatty acids which are as essential in keeping body's normal functions. It is better than some livestock's fats. Since mashed goose meat contains a great deal of proteins, trace elements, especially in calauim and phosphorus, it can be used as an ideal nutrient enhancer.

3. β-cyclo dextrin is as a desirable de-fishyness agent in goose products.

4.Polyphophates can promote the ability of WHC in goose obviously, the effection of triphophate sodium and pyrophosphate

sodium are better than hexametaphosphate sodium.

5. Isolated soya protein and carrageenin can be used as good quality conditioner, they contribute both in promoting the product output and in improving the product structure and texture of the products.

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