

# PRESERVATION OF THE NAN-AN PRESSED SALTED DUCK WITH MICRO-WAVE IRRADIATION

Zhou Yongchang and Ding Qingbo, Department of Animal Science, Jiangxi Agricultural University, Nanchang City, Jiangxi Province, China

## SUMMARY

The Nan-An pressed salted duck is one of the Chinese traditional export commodities. The early pressed salted duck (produced during August to October) could only be preserved against decay for about 15 days. In order to prolong the preservation and expand the export, this test was designed. In the preservation experiment, the optimal power and proper irradiation time of micro-wave were selected. The ducks treated or untreated by the micro-wave were kept for three months in general temperature. The sense, physicochemic indexes and the quantity of micro-organism were determined. All of the results indicated that the micro-wave killing bacteria is a good method for Nan-An pressed salted duck preservation. It could preserve the ducks against decay for three months, even longer.

## INTRODUCTION

The Nan-An pressed salted duck, initially from Da-Yu county, Jiangxi province, China, with a history of more than one hundred years, was renowned as a traditional export commodity at home and abroad. It was deeply welcomed by domestic and foreign consumers with its beautiful shape, white skin, tender meat, fragile bone, moderate salt taste, delicious cured flavour, rich nutrition and some other characteristics. The processing course of Nan-An pressed salted duck included: selecting of duck, fattening, butchering, defeathering, cutting away of five outside parts (lower jaw, wings and feet), cutting open of chest to clean viscera, salting, fixing on board and forming of shape, shining in the sun, determining of degree, and packing. The annual output in China reached more than 10,000,000 ducks, among which more than 1,500,000 ducks were sold to Singapore, Malaysia, Japan and other countries and the areas of Hong Kong and Macao for foreign exchanges nearly 10,000,000 dollars. The export output of Jiangxi province made up about 68% of the total export output. In comparing and appraising the quality of different pressed salted ducks of whole country in 1986, the factories of Rao-Feng, Nan-An, and Sha-Di in Jiangxi province were gloriously received the National silver medal. However, the early pressed salted duck produced under higher temperature of August to October, had a shorter shelf-life and were generally preserved only about 15 days due to producing pest and spoiling easily. Thus they were much limited to sell abroad. Meanwhile, the development of the pressed salted duck was objectively restricted and the productive enthusiasm was affected. Therefore, study on preservation technique of the Nan-An pressed salted duck was a scientific research subject with obvious economic and

social benefits. It was of great significance in promoting the enterprise of poultry raising, accelerating the development of processing, meeting the needs of the markets at home and abroad and increasing export foreign exchanges.

Food preservation by killing microorganisms with micro-wave was a new technique developed recently in the world. In the 1960's, AKAHOCI, TAKHHARA, DOHARA and other Japanese scientists used the electronic micro-wave oven to kill the bacteria and pests in fish, meat, raw bean curd, breads and cakes, and prevent them against spoilage by the micro-wave. This test confirmed the effect of micro-wave, which workers in many countries gave attention to. At present, millions of families in developed countries use the micro-wave oven as a cooking equipment at home, while it is still in the experimental stage in China.

The present study was conducted to determine the effect of micro-wave on preservation of Nan-An pressed salted duck.

## MATERIALS AND METHODS

Eighty second-grade Nan-An pressed salted ducks produced with the traditional method in the Long-Hui and Rao-Feng pressed salted duck factories were randomly selected in September of 1985 and 1986. They were divided into two groups (control and treatment group) of 40 ducks each. The control ducks were not treated by any way. In treatment group, each duck was held in 40 x 40 cm polypropylene compound plastic bag with transparency, good airtight, and no taste and poison. The mouth of the bag was blocked by a heat shutting engine under normal pressure, and then it was treated by the ER-692 micro-wave stove produced in Japan. The technical function of the stove was that the micro-wave exporting efficiency was 650 watts and the micro-wave working frequency was 2,450 MHz. After the selected test, the micro-wave with middle strength was used to irradiate for sixty seconds.

The pressed salted ducks were stored under natural condition in a general room. The ducks were observed for sense evaluation and assessed at a regular interval to determine the physicochemical indexes including moisture, total volatile basic nitrogen (TVB-N), peroxide value and acid value, which showed the freshness of duck. The microbic index was also determined at the beginning and the end of the experiment. The room temperature was recorded three times every day. All indexes were analysed according to the standard method of National analysis test.

TABLE 1 The storage temperature of pressed salted ducks in preserving test.

Month	Sep.	Oct.	Nov.	Dec.
Mean temperature (°C)	25.3	19.6	13.1	4.8
The highest temperature (°C)	36.6	34.6	22.4	17.5

TABLE 2 Sense determination in storage test of pressed salted ducks.

Group	Storage days	Slight spoilage (%)	Heavy spoilage (%)	Spoilage efficiency (%)	Normal efficiency (%)
Control	15	8.6	71.4	80	20
	30	20.7	79.3	100	
	60	12.5	87.5	100	
	101	8.1	91.9	100	
Treatment	15				100
	30				100
	60				100
	101				100

TABLE 3 The physicochemical index of ducks during the storage test.

Index	Group	15 days	30 days	60 days	101 days
Moisture (%)	Control	38.81	38.94	35.33	30.97
	Treatment	38.78	38.83	41.34	42.05
TVB-N (mg/100g)	Control	6.31	9.27	15.19	22.67
	Treatment	3.23	3.61	3.89	7.43
Peridexie value (%)	Control	0.17	0.35	0.39	0.43
	Treatment	0.16	0.16	0.21	0.27
Acid value (%)	Control	0.92	1.93	2.37	3.73
	Treatment	0.68	0.81	0.97	1.19

TABLE 4 The microbial result of the Nan-An pressed salted ducks during the storage test;

Index	Control group		Treatment group	
	Initial	101 days	Initial	101 days
Bacteria counts (num/g)	0.8 X10 <sup>5</sup>	819 X10 <sup>5</sup>	0.8 X10 <sup>5</sup>	1.74 X10 <sup>5</sup>
Bacillus coli counts (num/100g)	30	30	30	30
Pathogenic bacteria	0	0	0	0

## RESULTS AND DISCUSSION

### 1. The temperature changes of experiment place

See Table 1.

### 2. Sense determination - the state of spoilage

See Table 2.

It was known from Table 2 that the treatment group was not spoiled from beginning to end. This result indicated that the micro-wave had an effect on the mould. However, 80% ducks in the control group was spoiled within 15 days. Then, the spoilage efficiency was increased as the experiment time prolonged and reached 100% within 30 days.

### 3. Determination of physicochemical index:

Physico-chemical indices could mainly reflect the fresh degree of the ducks. Table 3 exhibited the results.

(1) **Moisture:** measured for 5 hours under the temperature of 105°C.

(2) **TVB-N:** this index represented the degree of protein disposition in muscle. It was measured by the Kjeldahl micro-nitrogenmeter and expressed with mg of nitrogen per 100 g pressed salted duck.

(3) **Peridoxic value:** represented the degree of oil-fatty oxidation, reflecting with percentage of Iodine.

(4) **Acid value:** represented the quantity of free fatty acid separated from oil-fat, expressing with mg of KOH.

According to the National Food Hygiene Standard, TVB-N must be 15 mg/100 g, Peridoxic value 0.4%, Acid value 3 mg/g (KOH).

Comparing with the National Food Hygiene Standard, all the items of the ducks in treatment group accorded with the standard, but the values in control group were higher than those of the standard.

There were significant differences between the control and treatment group in physicochemistry (P.01). The treatment by micro-wave could maintain the original weight of the pressed salted ducks. However, the moisture in untreated ducks was reduced evidently, which resulted in economic loss because of the reduction of duck weight.

### 4. Microbial result was shown in Table 4

The bacteria counts in treated ducks after preservation for 101 days were twice as those at the beginning, but the bacteria counts in control ducks preserved for same days were 100 times as initially. The result indicated that the micro-wave could inhibit and kill the bacteria in ducks. It was the key of the preservation by micro-wave.

The following conclusions were suggested according to above results:

1. The Nan-An pressed salted duck, packing in an airtight plastic bag and treated by 2450 MHZ micro-wave (middle strength) for 60 seconds, could completely be preserved well. The preservable term of treated ducks was significantly prolonged at normal temperature. The pressed salted ducks processed during August to October usually could be preserved for only about 15 days, while those treated by micro-wave could be preserved for 90 days, or even longer. This technique of preservation for pressed salted ducks, with certain advancement and practical significance, was not reported in the world.

2. The micro-wave had an obvious effect in killing bacteria, preventing against mould, and eliminating pests. The bacteria counts of the ducks in treatment group were  $1.74 \times 10^5$ /g duck, and there were no any spoilage in these ducks after preserving for 101 days. However, the ducks in the control group began to spoil at about the day 7, and completely spoiled, and darkened and some had pest in 15 days of preservation.

3. The ducks treated by micro-wave maintained the originally good qualities in colour, flavour, odour and shape. In the major physicochemical indexes, they corresponded to the National Food Hygiene Standard and there were marked differences between control and treatment group.

4. It would be more effective if the deoxidiser was added in the pressed salted duck on the basis of micro-wave treatment. The reason was that the fatty oxidation and the growth of the aeromicrobe were prevented effectively under the condition of absent oxygen. The colour kept fresh and the preservation effect was increased.

5. Killing bacteria with micro-wave had the advantages for preservation of ducks, including the high efficiency of heat transformation, well-distributed heat to ducks, quick kill-bacteria (only need several seconds or minutes, strong penetration (can reach the food deep), safety, no residual and pollution, easy automation (can greatly save the labour). It was a new technique for food preservation, which could be used widely in heating, vapouring, drying, bacteria-killing and pest-eliminating of food.

## **THE PROCESSING METHOD OF THE NAN-AN PRESSED SALTED DUCK**

Zhou Yongchang and Ding Qingbo, Department of Animal Science, Jiangxi Agricultural University, Nanchang City, Jiangxi Province, China.

### **THE SEASON OF THE NAN-AN PRESSED SALTED DUCKS PROCESSING**

The season of the Nan-An pressed salted ducks processing are from Autumnal Equinox to Great Cold every year. Among them, it is the best time to process the ducks from the beginning of winter to Great Cold. According to the difference of the processing season, they can be divided into three groups: the early pressed salted ducks (the middle ten days of September to the last ten days of October); the middle pressed salted ducks (the first ten days of November to the first ten days of December), and the later pressed salted ducks (the middle ten days of December to the middle ten days of January next year). The quality of the later pressed salted ducks is best among them.

### **THE PROCESSING TECHNOLOGY OF THE NAN-AN PRESSED SALTED DUCK**

The processing technology of the Nan-An pressed salted ducks mainly includes the selecting of the ducks, fattening, slaughtering, defeathering, cutting outer five pieces, opening its chest and cutting off the viscera, salting, exposing in day and night, and shaping.

#### **SELECTING OF THE DUCKS**

Nan-An pressed salted ducks are processed from the Big Gunny Ducks. Big Gunny Ducks have been bred through the crossing of Deng Fuang female gunny ducks of Nanxiong, Guangdong, with the local gunny drakes since the year 1930. This breed is high quality for meat and eggs. The shapes of the ducks are middle, the head is slightly big in size, the mouth blue, the skin white, the feet blue with some yellow. The black of the female's feather is very big and very deep, the main feather has black green, so it's called Big Gunny Duck. The feather in the head, neck, back and stomach of the drake are brown. Some heads are in black green. The main feathers are black green, but some of them are white, so it's called Hong Mao Gu. The Big Gunny Ducks are strong in adaptability, grow fast, high in product, tender meat, thin skin and small pore in the skin, and it's easy to process the pressed salted ducks.

#### **FATTENING**

Big Gunny Ducks (1.25-1.75 kg weight), feed 90-100 days, are selected and feed in the shed. The period of fattening is generally 28-30 days. The fattening ends, when the new feathers in the head of the duck grow up again. Generally, the weight of the duck can increase about 0.25 kg in the period of fattening and it consumes 4-5 kg rice.

The place of fattening usually lies in the area where there are transport facilities but is out-of-the-way. The size of the shed is usually 9 m. It can contain 80 ducks during hot days and about 110 ducks during the cold days.

After fattening, the processed pressed salted duck has white skin and fat, tender meat and fusion point of the fat is increased. The pressed salted duck must avoid oil to keep from spoilage.

#### **SLAUGHTERING**

##### *1. Prepare before slaughter:*

The gross duck must be stopped from feeding 12-16 h before slaughtering but drink enough water. It should be stopped from drinking water 2 h before slaughtering to prevent pollution. Stopping feeding can make the food in the gastrointestinal of the duck digested clean and prevent it from polluting the duck. Drinking water can retain the normal physiological function of the duck. Part of the protein in the duck is catabolised into amino acid, and the meat becomes tender and fresh after stopping feeding.

##### *2. The position and method of slaughtering:*

The duck is killed in the neck or in the first cervical vertebra connection with the headbone.

Two operators should help each other well during the slaughtering. One operator holds up the wing and the left foot of the duck with his left hand. The other holds the duck's head with his left hand and holds a knife with his right hand and kills the duck in the connection of the first neck cervical vertebra with the duck's head. It should cut all of the neck arteries, tracheal and esophagus, but must not cut off the head. The blood must flow up the body to avoid polluting the duck and affecting the quality.

#### **DEFEATHERING**

The dead duck, which has not lost the quantity of heat, is put into the boiling water at once, otherwise it is very difficult to pull out the duck feathers after the duck becomes cold and the pores contract. The temperature of the water for artificial scalding feather is about 60-70°C and the time for scalding is 1.5-2 min. The duck should be taken out and the feathers pulled out as soon as possible after completely scalding the duck.

The order for pulling out the feathers is: head neck, wings, shoulder back, chest abdomen, tail. The method for pulling out the feathers is that the neck is pulled out with finger, because the skin of the neck moves and breaks easily; the feathers of the shoulder back should be pushed and moulted because the feathers are too close; the abdomen should be grasped to pull out the feathers, because the feathers possess soft and high resilience; the feathers of the two wings and the tail must be pulled separately, because they are very thick. The webbed foot coatings are pulled out completely and the break coatings must not be cleaned up and pulled over 3-5 cm to the break point. This symbolises the characteristic of Big Gunny Duck made Nan-An pressed salted duck.

#### **CUTTING OUTER FIVE PIECES**

Outer five pieces include the two wings, two legs and lower jaw with tongue. The duck will be lain supine when the outer five pieces are cut. The operator catches the lower jaw by his left hand and mouth of the duck is cut with a knife by his right hand, then the lower jaw with tongue is cut off by his right hand. The operator catches the left upper wing bone by his left hand and cuts from the elbow articulation, then the upper wing bone is cut

off. The left webbed foot is caught by the left hand and cut from the tarsal articulation. The right webbed foot and the right wing are cut off in the same way.

The edge of the knife must be pointed to the bone seam, which can protect the bones and muscles from harm and affecting the appearance of beauty.

#### **THE FIRST TECHNOLOGY (OPENING THE CHEST)**

The duck is laid supine on the operating table. The tail of the duck points towards the operator. The operator pressed the abdominal middle line (outer line) about 0.8-1.0 cm to the left side of the duck with his hands, then the operator presses upon the handle of the breastbone and the xiphoid cartilage, fixes the abdominal middle line with his left hand, and holds a knife with his right hand. The operator begins to cut from the handle of the breastbone and along the abdominal middle line, cuts up the skin and the breast muscles, then exposes a white line (inner line), and cuts along the inner line again. The thoracic and abdominal cavity is opened. The left side of the duck is bigger than the right side, so the left is called big side and the right is called small side. Both sides of the duck are pressed and opened up, then the viscera are exposed.

The first technology is strict. After opening the thoracic abdominal cavity, the muscles of the big side have the appearance of a longitudinal ditch, the section of the breastbone appears upon a shape like a sickle. The small side has the appearance of a white edge.

#### **DIGGING UP THE VISCERA**

The trachea is pulled apart at the joint of the lung, then the heart and the liver are pulled out. The faeces in the rectum are pushed through to the anus. The rectum is pulled apart to near the anus about 3 cm, then the viscera are pulled out. Finally the lung is cut off. The blood and the faeces cannot pollute the duck, when the viscera are cleaned.

#### **THE SECOND TECHNOLOGY**

First the testis, the ovary and the remaining viscera are cut off and put on the operating table. The knife is put on the right ribs. The front edge of the knife is close to the thoracic vertebrae. The operator beats on the back of the knife and ribs will be cut off. The other side ribs are cut off the same way. While the ribs are being cut, the last two ribs remain in the female duck, but the ribs are all cut off in the drake to make the shape circular. Finally, the remaining rectum, the reproductive organs and the anus are cut off. However the anus is only cut one third to make it shaped like a new moon. This is also a characteristic of the Nan-An pressed salted duck.

#### **SALTING**

##### *1. Preparation of salt:*

The tiny white salt is put into an iron pot and fried over a strong fire until it does not give off any water vapour. The salt must be used after it gets cold. If it has not been used up at the present day, it must be fried again the next day.

##### *2. The salt quantity:*

The early stage duck uses 150-200 g. The later duck uses 125 g.

##### *3. The order and the method of salting:*

The duck is put on a salting board. The cervical vertebra is pulled 3-4 cm out and salted with some salt, then put back. The neck is salted 5-10 times and the cut section of the head is salted again. The cut sections of the big and the small side are down and are pulled from the salting board to make them salted. Then the duck is spread on the salting board, the duck skin up towards the duck head towards the operator. The operator salts the skin of the duck and salts strongly back and forth with his hands. The early duck is salted 50-60 times and the later duck is salted 15-20 times. Generally, the thigh, the big side and the tail muscles are thick, so they should be salted 5-10 times more. When salted, the skin should not be broken.

##### *4. Salting in a vat:*

The head neck of the salted duck is bent to the thoracic abdomen. The big side lies in the vat wall, the small side close to the centre of the vat. The skin is sown at the bottom of the vat. The ducks spiral up with a duck pressed on two thirds of another duck. The duck has a certain inclination gradient which is helpful to salt thoroughly the tail which has thick muscles. After the ducks have been put in the vat, the centre of the vat is vacant. Sometimes the cover with a hole is covered to prevent the ducks from animals harm and to observe well the salting condition.

##### *5. The time of salting:*

It is generally 8-12 h. The time of salting is longer in hot weather and shorter in the cold weather. The salt cannot penetrate the inner muscles when the time of salting is too short, and the duck will spoil easily. If the time of salting is much longer, the colour of the duck's skin will be affected, the taste of salt is too strong, and the muscles get stiff, because of contracting strongly.

#### **WASHING**

The ducks are taken out from the vat, when the time of salting is ended. First the ducks are washed in the mild water (about 40°C) to get rid of the crystal salt which has not dissolved, then the duck is put in mild water (40-50°C) and washed 3 times. When soaked, the duck should be turned over from time to time. The remaining viscera, the wastes and tail fat glands should be gotten rid of. When the stiff duck gets soft, it can be shaped.

When the ducks are washed, the temperature of the water must be controlled well. If the temperature is too low, the polluting wastes cannot be cleaned easily, the body will get soft and it is difficult to shape in a stretch board. If the temperature is too high, the skin will be scalded easily, and the fat will be dissolved. So the quality of the duck will be affected.

#### **SHAPING IN THE STRETCH BOARD**

The shaping board is 2 m long and 0.63 m wide, it is made of absorbent, light and solid wood. The board must be often rinsed to keep it clean from polluting. Twenty ducks can be shaped on the board.

After the duck is washed, the last number 4 to 5 cervical vertebra of the duck is dislocated, then the duck with the skin up towards and the tail forwards is put on the board. The operator fixes the duck with his right hand, puts his left hand on the right thighbone, dislocates the thighbone

muscle and the thighbone is dislocated forwards. So the muscles appear thicker and the duck has a fine exterior. The left thigh is stretched in the same way. After the thighs are stretched well, the duck is spread on the board. Finally, the wings are put on the board well, and the head is bent to the right side.

After the duck is taken shape well on the stretched board, the tail lies to westwards and the big side to southwards for cooling and shining, the small side appears a white side in which the skin is beyond the muscle about one centimetre, the anus appears a new moon. When the skin is slightly dry, the seals which mean Nan-An pressed salted duck are affixed on each wing and thigh.

#### **ROPING AND SHINING**

After the stretched board has cooled and shone 4-6 h, the shape of the duck has been fixed. The duck is put well in the order and a hole is made in the big side (about 5 cm in front of the thoracic bone, about 1.5-2.0 cm to the big side cut sections) by an iron needle. A 50 cm long tiny flaxen rope is put through the hole in the duck and tied close to the thoracic bone.

A 4 m long bamboo pole is put into the rope circles. Twenty ducks in a pole are put up on the shining shelf to

expose in the night and shine in the day. When exposed and shone, the board lies to southwards and the tail to westwards. The tail of each duck is covered by another duck but the last duck, which make the duck get dry easily.

Generally, after the duck was exposed in the night and shone in the day for 5-7 days, the muscles of the small side appear in rose red colour and five to seven hard cervical vertebrae can be seen clearly through the skin. It indicates that the duck has been dried, or it can be stored and packed.

If the weather is not fine, the ducks should be carried into the stove to be toasted. When the ducks are toasted, first the temperature of the stove should be controlled to 30°C, then ducks are put up on the toasting shelf. At first, the temperature of the stove can be raised up to about 50°C. After two hours, the ducks are put out for cooling. The ducks are put into the stove to be toasted, where the skins become white like milk. The temperature is controlled to 50°C. If the duck is toasted to dry one time, the skin has an appearance of dark red. The skins of the toasted or dried duck get white, and the ducks taste much of cured meat. It has been a story that dryness is the lifeline of the pressed salted duck and one dryness is one aroma.