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The Preservation of Chicken Meat 1. Chemical Changes

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THIS WORK was carried out to investigate the effect of antibiotic (10 ppm chloramphenicol) and packaging in polyethylene bags on the chemical changes of chicken meat at chilling and freezing temperatures. Dipping the carcasses in chloramphenicol have no effect on the fat percent of the skin in different periods of storage.

Higher fat percent of the unpackaged carcasses were more pronounced either treated or not, than the packaged group. The free fatty acids and the peroxide value of the skin fat increased gradually by the increase of storage time to reach their maximum values at the end of the experiment either at chilling or freezing conditions.

The treated carcasses had lower free fatty acids percentages and peroxid value that the untreated ones. The peroxide value in the packaged carcasses were lower than that of the unpackaged ones. The difference between the two groups were mainly dependent on the degree of surface drying, while the unpackaged carcasses had lower values of free fatty acids percentages either treated or not than the packaged ones. The antibiotic delay the hydrolitic and oxidative rancidity. Also, packing the carcasses in polyethylene bags is important to delay oxidative rancidity,while packing showed less importance in delaying hydrolytic rancidity. The amino acid nitrogen of the breast and leg meat increased by the increase of storage time. The packaged carcasses had slightly higher values of amino acid nitrogen than the unpackaged ones. Dipping the carcasses in antibiotics gave lower values of amino acid nitrogen than the untreaed ones.

Rancidity is associated with the oxidative and hydrolytic chemical changes occurring in stored fat, and the peroxide oxygen and free fatty acid formation are a measure of these chemical changes (Baker *et al.*, 1956). Cook and White (1940) found that, peroxide formation resulted from exposing the surface to the air which also caused drying and free fatty acid content of poultry fat after storage is usually low and shows no relation to storage conditions. Rancidity was significantly higher in polyethylene packaged carcasses than in vinylidene (Thomson, 1970). Under frozen storage, there was a gradual deterioration of the fat, most of the values (peroxide and acid value) indicate that, this deterioration starts immediately after the carcasses were stored and continued until the carcasses have been stored for14 months at - 23.3°. (Conner *et al.*, 1953).

During the storage periods at 4.4°, the amino acid nitrogen values of the breast meat were higher than that of the skin, and the production of ammonia nitrogen from degradation of tissue protein was associated with the detection of spoilage by organolyptic examination (Silvestrini *et al.*, 1958). High values of ammonia nitrogen were obtained from skin and breast muscles of the untreated samples, while the use of 10 ppm of chlortetracycline (CTC) or oxytetracycline (OTC) resulted in much lower values (Silvestrini *et al.*, 1959).

Proteolysis may occur in poultry tissues during freezing or freezing storage if enzymes are not inhibited. Khan *et al.* (1963) found that, proteolysis occurred in both breast and leg muscle at - 18°, - 10°, and - 4°, and the amount of free amino acids and other protein-breakdown products increased as a result of proteolysis. The rate of these changes depended directly on storage temperature and time. The formation of ammonia was completely inhibited by using stretchable or shrinkable polyvinyl-chloride film, however, the formation of ammonia was slightly inhibited when polyethylene film was used (Debevere and Voets, 1973).

Material and Methods

This work was carried out at the Poultry Experimental Centre, Animal Production Department,and Food Science Department, Faculty of Agriculture, Cairo University.

A total of 140 Fayoumi chickens were used in this experiment. The chickens were used to study the effect of chloramphenicol and packaging on the shelf-life of chicken meat at chilling and freezing temperatures.

The chicks were raised in the floor brooder house from hatch up to eight weeks of age, then removed to the broiler house until sixteen week old. The slaughter was done at 16 weeks, that averaged 0.90 to 0.95 kg in live weight.

The chickens were dressed under conditions that would be found in most dressed plants. The eviscerated birds (average weight 0.6 to 0.7 kg), were divided into two groups.

Chilling storage

40 carcasses were taken randomly and placed under chilling condition. The carcasses were divided into two sub-groups.

Sub-group 1, were 20 carcasses were put in iced water at 5° for 20 min. In sub-group 2, 10 ppm of choloromyctein (chloramphenicol) were added to the iced water, where 20 carcasses were put for 20 min. Each carcass in the two sub-groups was banded and weighed to the nearest gramme (Original weight) and packaged individually in polyethylene bags and tied firmly.

Packaged carcasses in the two sub-groups were stored in home type refrigerator at about 5 ± 1°. For the duration of the testing period (15 days). Four carcasses from each sub-group were tested chemically at 3, 6, 9, 12 and 15 days of storage.

Freezing storage

96 carcasses were taken randomly and placed under freezing condition. Theses carcasses were divided into four sub-groups.

Sub-group 1, consisted of 24 carcasses, which were put in iced water at 5° for 20 min (untreated-unpackaged).

Sub-group 2, after bien chilled as in sub-group 1, the carcasses were packaged individually inpolyethylene bags and tied tightly (untreated-packaged). In sub-group 3, 10 ppm of chloramphenicol were added to the iced water, where 24 carcasses were put for 20 min (treated-unpackaged). The 24 carcasses of sub-group 4, after being chilled as in sub-group 3, were packaged individually in polyethylene bags and tied tightly (treated-packaged). All sub-groups were stored in a freezen room at about — 10 ± 1° for 180 days. Four carcasses from each sub-group were sampled every 30days from freezing storage. Each carcass was banded and weighed individually to the nearest gramme (Original weight).

All carcasses in the two groups were packaged in polyethylene bags either at chilling or freezing temperatures. These bags were 40 cm long and 22 cm wide. When the carcasses were packaged, excess air was removed by hand pressing on bags, no mechanical evacuation was used.

Control samples of fresh carcasses (4 carcasses) were taken for chemical tests. These were considered to be zero time (at slaughter).

Chemical analysis

1. *Rancidity tests* :

The skin was removed and minced thoroughly for fat determination by extraction with petroleum other (B.P. 30 - 50°) for six hr using a Soxhlet apparatus (A.O.A.C. 1960). After extraction, the extracted fat was analyzed for hydrolytic rancidity by estimating the free fatty acid percentage (expressed as oleic acid), the results were expressed as acid value. The oxidative randicity was follower through the peroxide number as recommended by Williams (1966).

2. *Deterioration of protein*

The breast and leg muscles were separated and minced thoroughly. The dissection and mincing were done so rapidly that, the meat temperature did not exceed 10°. Duplicate samples from breast and leg meat were used in amino nitrogen determination using the Sorenson method as described in the A.O.A.C. (1960).

Statistical analysis

Statistical analysis were carried out according to Steel and Torrie (1960).

Results and Discussion

1. *Fat percent in the skin*

The fat percent in the skin of the treated and the untreated carcasses did not show any pronounced change during chilling storage (Table 1). The treated carcasses had higher fat percent in their skin than that the untreated ones at different storage periods. This could be attributed to the low moisture percent in the skin of the treated carcasses. Analysis of variance showed that there were highly significant effect of treated and storage periods on fat percent in the skin (Table 3).

Fat percent in the skin of the frozen carcasses increased by the increase in freezing time (Table 2). Most of the increase was observed in the unpackaged than the package carcasses. As slight but significant increase was observed in the skin may be due to the lower moisture content in it, because there is an inverse relation ship between fat and moisture.

Analysis of variance showed that there were highly significant effect of treated, storage periods and packaging on fat percent in the skin (Table 4).

2. *Rancidity*

a. Free fatty acids (acid value)

During the first half of the chilling storage period, both treated and untreated carcasses had nearly equal values. However, during the second half of the storage period, the untreated carcasses had higher values than the treated group. The skin of the untreatd carcasses gave a more suitable medium for bacterial growth due to its relatively higher moisture content than the treated carcasses (Table 1). The antibiotic used in this experiment decreased the growth of lipolytic bacteria which might have caused the hydrolysis of fats to free fatty acids and glycerine. This was also emphasized by Rey and Kraft (1971). The differences in acid value due to treatment, storage periods and the interaction between them were highly significant (Table 3).

Acid value in the skin fat of the frozen carcasses increased gradually by the increase of the frozen storage to reach its maximum values at the end of the experiment (Table 2). The package carcasses had higher percentages of free fatty acids either treated or not than the unpacked ones. The unpackaged carcasses lost more moisture from the skin which is unsuitable medium for bacterial growth.

Therefore, rancidity was significantly higher in the packaged carcasses than the unpackaged groups. Thompson (1970), came to the same conclusion. These results showed that, dipping the carcasses in chloramphenicol have more effect on decreasing the hydrolysis of fats to free fatty acids, while the polyethylene bags had no effect. The differences in acid values due to packaging, treatments, storage periods and interactions between them were highly significant (Table 4).

TABLE 1. **Effect of chilling on the chemical characters of the stored carcasses.**

Item	Storage periods (Days)					
	At slaughter	3	6	9	12	15
Fat % in skin(1) (Tr.)	11.08	12.01	14.12	13.64	14.85	13.06
Fat % in skin (Unter.)	11.08	11.04	12.13	13.08	13.01	12.73
Acid value(2) in skin fat (Tr.)	0.86	0.93	1.14	1.35	1.89	2.18
Acid value in skin fat (Untr.)	0.86	1.16	1.98	3.08	3.74	5.68
Peroxide value(3) in skin fat (Tr.)	4.12	8.66	11.87	16.44	18.60	19.95
Peroxide value in skin fat (Untr)	4.12	9.75	13.73	17.84	25.36	28.88
Amino acid nitrogen(4) in breast meat (Tr.)	15.47	19.64	28.71	46.40	69.39	94.81
Amino acid nitrogen in breast meat (Untr)	15.45	38.46	38.46	74.81	113.93	147.07
Amino acid nitrogen in leg meat (Tr.)	14.19	18.15	24.82	33.09	53.19	76.21
Amino acid nitrogen in leg meat (Untr.)	14.19	23.40	30.76	62.38	99.83	131.05

(1) As wet basis.
(2) Free fatty acids, calculated as percentage of oleic acid.
(3) Expressed as milliequivalents of peroxide oxygen/one kg of skin fat.
(4) Calculated as mg/100 g of meat.

TABLE 2. Effect of freezing on the chemical characters of the stored carcasses.

Items	Storage periods (Days)						
	At slaughter	30	60	90	120	150	180
Fat % in skin(1)(Pack., Tr.)	11.08	12.15	10.83	13.37	11.60	11.91	13.78
Fat % in skin(1)(Pack., Untr.)	11.08	10.97	10.80	12.64	12.75	10.39	12.25
Fat % in skin(1)(Unpack., Tr.)	11.08	17.23	20.70	24.39	29.30	32.64	36.91
Fat % in skin((1)Unpack., Untr.) . . .	11.08	12.02	13.77	15.68	25.75	28.06	32.19
Acid value(2) in skin fat (Pack., Tr.) . .	0.86	1.26	1.68	2.10	4.24	6.45	9.61
Acid value(2) in skin fat (Pack., Untr.) .	0.86	2.52	3.36	6.22	12.48	15.25	18.12
Acid value(2) in skin fat (Unpack., Tr.)	0.86	0.94	0.99	1.18	1.38	3.05	2.27
Acid value(2) in skin fat (Unpack. Untr.)	0.86	0.98	1.13	1.39	1.64	3.28	3.76
Peroxide value(3) in skin fat (Pack., Tr.)	4.12	6.64	8.48	11.52	12.85	15.74	16.37
Peroxide value(3) in skin fat (Pack.,Untr)	4.12	8.28	10.25	14.79	15.02	19.70	24.35
Peroxide value(3) in skin fat (Unpack., Tr.)	4.12	10.21	16.37	20.63	25.91	31.85	35.66
Peroxide value(3) in skin fat (Unpack., Untr.)	4.12	13.50	19.49	24.82	30.56	38.93	51.17

TABLE 2. (*Cont.*)

Items	Storage periods (days)						
	At slaughter	30	60	90	120	150	180
Amino acid nitrogen(4) in breast meat (Pack., Tr.)	15.47	23.35	26.94	34.05	41.65	64.50	88.57
Amino acid nitrogen(4) in breast meat (Pack., Untr.)	15.47	25.89	32.81	43.73	69.64	109.87	146.92
Amino acid nitrogen (4) in breast meat (Unpack., Tr.)	15.47	17.64	20.49	24.36	29.08	43.86	68.39
Amino acid nitrogen (4) in breast meat (Unpack., Untr.)	15.47	19.81	23.47	28.43	34.39	49.20	75.67
Amino acid nitrogen in leg meat (pack., Tr.)	14.19	19.65	22.14	28.45	34.87	48.46	69.30
Amino acid nitrogen in leg meat (Pack., Untr.)	14.19	23.84	29.37	36.58	58.19	92.65	124.27
Amino acid nitrogen in leg meat (Unpack Tr.)	14.19	15.94	18.89	21.98	25.67	33.45	42.29
Amino acid nitrogen in leg meat (Unpack., Untr.)	14.19	17.39	21.55	25.88	30.43	43.64	49.96

(1) As wet basis.
(2) Free fatty acids, calculated as percentage of oleic. acid.
(3) Expressed as milliequivalents of peroxide oxygen/one kg of skin fat.
(4) Calculated as mg/100 g of meat.

TABLE 3. ANOVA for fat % in the skin, acid value, peroxide value in skin fat and amino acid nitrogen value in breast and leg meat at freezing temperature.

Segments	S.V.	d.f	M.S.	F
Fat % in skin. ..	Between treatments	1	9.32	29.78++
	Between periods	4	4.58	14.63++
	Interaction	4	0.73	2.34
Acid value in skin fat	Between treatments	1	82.98	284.18++
	Between periods	4	33.99	116.39++
	Interaction	4	6.36	21.76++
Peroxide value in skin fat	Between treatments	1	160.64	278.89++
	Between periods	4	316.29	549.12++
	Interaction	4	25.87	44.91++
Amino acid nitrogen value in breast meat	Between treatments	1	8380.45	43.73++
	Between periods	4	12948.41	67.56++
	Interaction	4	4900.28	25.57++
Amino acid nitrogen value in leg meat	Between treatments	1	7393.24	68.10++
	Between periods	4	9771.09	90.00++
	Interaction	4	1051.86	9.69++

++ Highly significant ($P < 0.01$).

b. *Peroxide value*

The peroxide number increased by the increase in storage time. However, a slight but significant increase in peroxide number was observed in the untreated over the treated carcasses at the first 9 days of storage at chilling temperature. Later on, increasing difference between the groups was observed until the end of the experimental time (Table 1). Packaging the treated or untreated carcasses did not prevent oxidative rancidity. Thompson (1970), also found an increased peroxide number even in polyethylene packed carcasses. Analysis of variance showed that there were highly significant effect of treated and storage periods on peroxide number in the skin fat (Table 3).

Under conditions of frozen storage, there was a gradual deterioration of the skin fat. The peroxide value indicates that this deterioration started immediately after the carcasses were stored and continued until the end of the experiment at 180 days reaching the maximum values (Table 2). The oxidative rancidity increased in carcasses without bags, while, the polyethylene bags assisted in causing some protection against rancidity (Hartung and Osborn, 1965).

Poultry fat is higher in unsaturated fatty acids, since most of the fat is locaated under the skin, rancidity occurs more readily because of the unsaturation and is accelerated by oxygen.

TABLE 4. ANOVA for fat % in the skin, acid value, peroxide value in skin fat and amino acid nitrogen value in breased and leg meat at freezing temperature.

Segments	S.V.	d.f.	M.S.	F
Fat % in skin	Between packagings (P)	1	1790.12	1790.12++
	Between treatments (T)	1	104.52	104.52++
	Between periods (Pe)	5	142.18	142.18++
	Interaction P x T	1	86.51	86.51++
	P x Pe	5	97.89	97.89++
	T x Pe	5	4.54	4.54++
	P x T x Pe	5	2.24	2.24
Acid value in skin fat	Between packagings (P)	1	1056.10	2456.05++
	Between treatments (T)	1	275.51	640.72++
	Between periods (Pe)	5	226.51	526.77++
	Interaction P x T	1	167.61	389.79++
	P x Pe	5	57.70	134.19++
	T x Pe	5	8.77	20.40++
	P x T x Pe	5	3.52	8.19++
Peroxide value in skin fat	Between packagings (P)	1	4028.10	3729.72++
	Between treatments (T)	1	560.33	518.82++
	Between periods (Pe)	5	1075.03	995.40++
	Interaction P x T	1	45.09	41.75++
	P x Pe	5	183.26	169.69++
	T x Pe	5	51.51	47.69++
	P x T x Pe	5	250.07	231.55++
Amino acid nitrogen value in breast meat	Between packagings (P)	1	12441.75	1195.17++
	Between treatments (T)	1	5228.44	502.25++
	Between periods (Pe)	5	12768.34	1225.55++
	Interaction P x T	1	2505.83	240.71++
	P x Pe	5	1166.17	112.02++
	T x Pe	5	610.50	58.65++
	P x T x Pe	5	452.02	43.42++
Amino acid nitrogen valuei n leg meat	Between packagings (P)	1	9590.00	1809.43++
	Between treatments (T)	1	4900.61	924.64++
	Between periods (Pe)	5	6614.63	1248.04++
	Interaction P x T	1	2093.84	395.06++
	P x Pe	5	1313.95	247.92++
	T x Pe	5	585.76	110.52++
	P x T x Pe	5	349.03	65.86++

++ Highly significant ($P < 0.01$)

The unsaturated fats are not well protected from enzymic action by lowering the temperature (Peterson and Gunderson, 1960). Dipping the carcasses in chloramphenicol and packaging delayed the oxidative rancidity of the skin fat during frozen storage. The differences in peroxide value due to packaging, treatments, storage periods and the interaction between them were highly significant (Table 4).

3. *Amino acid nitrogen in the breast and leg meats*

The amino acid nitrogen in the breast and the leg meats increased by the increase in storage time (Table 1). Significant increase was observed in the untreated over the trated carcasses at any period of storage. This increase could be due to the multiplication of bacteria. This was also suggested by Tomhinison and Campbell (1963). They observed that, free amonia accumulated as a catabotic product of nitrogenous compounds due to the effect of pseudomonas as a strong proteolyte bacteria. Spoilage of breast and leg meat during chilling storage can be delayed by dipping the carcasses in chloramphenicol. Analysis of variance showed that there were highly significant effect of treated, storage periods and packaging on free amino acids in the breast and leg meat (Table 3).

The amino acid nitrogen in the breast and leg meat of the frozen carcasses increased gradually in all groups by the increase of frozen storage to reach its maximum value at the end of the the experiment at 180 days of storage (Table 2).

The unpackaged carcasses being of lower humidity had lower free amino acid nitrogen than the packaged ones. Therefore, spoilage of proteins was significantly higher in the packaged carcasses than the unpackaged groups. These results indicate that, the breast and leg protein underwent both denaturation and proteolysis during frozen storage and the formation of amino acids nitrogen was only slightly inhibited when polytehylene bags were used. This was also emphasized by Khan *et al.* (1963). The treated carcasses had lower values than the untreated ones at any period of freezing either the carcasses were packaged or not. The differences in the amino acid nitrogen in the breast and leg meat due to packaging, treatments, storage periods and the interactions between them were highly significant (Table 4).

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دراسات على تخزين ذبائح الدجاج الفيومى
أولا ـ التغيرات الكيميائية

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أجرى هذا البحث بكلية الزراعة ، جامعة القاهرة على ١٤٠ من دجاج الفيومى وذلك لدراسة تأثير غمر الدجاج فى محلول ١٠ جزء فى المليون من المضاد الحيوى كلورامفينكول (كلوروميستين) ، والتعبئة فى أكياس البولى ايثلين على اضافة مدة حفظ لحوم الدجاج عند درجات حرارة التبريد (+٥°م) لمدة ١٥ يوم ، والتجميد (−١٠°م) لمدة ١٨٠ يوم ـ تم ذبح الدجاج عند عمر ١٦ أسبوع ـ وأخذت العينات للتحليل الكيميائى كم ٣ و ٣٠ يوم فى التبريد والتجميد على التوالى وقدرت النسبة المئوية للدهن فى جلد الذبائح ومدى تزنخ الدهن فى جلد الذبائح بواسطة تقدير الأحماض الدهنية المنفردة (تزنخ تحللى) ورقم البيروكسيد (تزنخ أكسيدى) ـ وتحلل البروتين (أحماض أمينية نيتروجينية منفردة) .

١ ـ النسبة المئوية للدهن فى جلد الذبائح

ليس هناك تأثير للمعاملة بالمضاد الحيوى على النسبة المئوية للدهن أثناء فترة التبريد بينما أثناء فترة التجميد لوحظ زيادة النسبة المئوية للدهن فى جلد الذبائح الغير مغلفة سواء كانت معاملة أو غير معاملة عن الذبائح المغلفة وهذا يرجع الى انخفاض الرطوبة فى جلد الذبائح الغير مغلفة .

٢ ـ فساد دهن جلد الذبائح

(أ) الأحماض الدهنية المنفردة (رقم الحموضة) فى دهن جلد الذبائح

قدرت الأحماض الدهنية المنفردة كنسبة مئوية فى صورة حامض أوليك فى دهن جلد الذبائح وقد وجد أن رقم الحموضة يزداد بتقدم فترات الحفظ ليصل لأعلى قيمة له عند نهاية فترة الحفظ سواء فى التبريد أو التجميد وأن الذبائح

المعاملة كان رقم الحموضة فيها أقل من الذبائح الغير معاملة وأيضا كان رقم الحموضة أقل فى الذبائح الغير مغلفة سواء كانت معاملة وأ غير معاملة عن الذبائح المغلفة وهذا يرجع الى أن الذبائح الغير مغلفة فقدت نسبة كبيرة من رطوبة جلدها مما جعل جلودها بيئية غير ملائمة للنشاط البكتيرى ٠

(ب) رقم البيروكسيد فى دهن جلد الذبائح

يزداد رقم البيروكسيد بتقدم فترة الحفظ سواء فى فترة التبريد أو التجميد ـ وكان أقل فى الذبائح المعاملة عن الغير معاملة بينما كان أعلى فى الذبائح الغير مغلفة عن المغلفة ـ وهذا يعنى أن تعبئة الذبائح فى أكياس البولى أيثلين يعطى لها حماية ضد حدوث التزنخ الاكسيدى ٠

ومن السابق نجد أن المعاملة بالمضاد الحيوى تؤخر حدوث التزنخ التحللى والاكسيدى وأن التغلف يؤخر حدوث التزنخ الاكسيدى بينما كان له أهمية أقل فى تأخير التزنخ التحللى ٠

٣ ـ الأحماض الامينية النيتروجينية فى صدر وفخذ الذبائح

تزداد الأحماض الأمينية النيتروجينية المنفردة فى صدر وفخذ الذبائح كلما تقدمت فترة الحفظ وقد وجد أن الصدر دائما يحتوى على أحماض أمينية نيتروجينيّة أعلى من الفخذ عند أى فترة حفظ سواء أثناء التبريد أو التجميد ٠ أثناء فترة التجميد كانت الذبائح المغلفة تحتوى على أحماض أمينية نيتروجينية أعلى من الغير مغلفة وهذا يرجع الى الجفاف الذى حدث فى الذبائح الغير مغلفة مما قلل من فساد البروتين فيها نتيجة لعدم تكاثر البكتيريا خاصة المحللة للبروتين ـ كذلك وجد أن الذبائح المعاملة كانت أقل فى محتواها من الاحماض الامينية النيتروجينية فى انسجتها عن الغير معاملة٠