BENHA VETERINARY MEDICAL JOURNAL, VOL. 23, NO. 1, JUNE 2012: 81-86

STUDY ON INCIPIENT SPOILAGE OF CHILLED CHICKEN CUTS-UP

Edris A.M.[a]; * Hemmat M. I.[a], Shaltout F.A.[a]; Elshater M.A.[b], Eman F.M.I.[b]
[a] Dept. Food Control, Fac. Vet. Med., Benha Univ., [b] Dept. Food Control, Animal Health Research

A B S T R A C T

A total of 15 random samples of cut-up chicken breast, thigh and drumstick (5 each) were collected from local slaughter poultry shops at Menoufiya governorate. The collected samples were examined at zero, 2, 4, 6 and 8 days of the refrigeration storage. The samples of different chicken cuts-up were analyzed for determination of pH, TVN and TBA to limit the critical point at which the spoilage of such food items is started (incipient spoilage). The obtained results indicated that the incipient spoilage of the examined breast, thigh and drumstick samples occurred at 2nd to 4th day, 4th day and 2nd day of storage respectively, based on their pH values .while, at 4th day, 4th day and 4-6th day respectively for TVN and at 6th days, 4th and 2nd to 4th day of chilled storage for TBA, respectively. Accordingly, the shelf life of the examined samples of chicken breast was longer than those of chicken thigh and drumstick.

KEY WORDS: Chicken cuts-up, shelf life, spoilage.

(BVMJ 23(1): 81-86; 2012)

1. INTRODUCTION

Spoilage of chicken meat during chilled storage is considered as one of the most important problems facing producers, distributors and consumers either on the local or international level. Factors such as temperature, time and conditions of storage are very important for microbial, chemical and physical changes in such food stuff [11].

Oxidative deterioration results in loosing the quality of chicken meat due to development of rancid odor and taste. Moreover, the rancid flavor can develop rapidly during refrigerated or frozen storage of chicken cuts-up which are more susceptible to rancidity because of their high contents of unsaturated fatty acids [3]. Although many workers studied the microbial spoilage of chicken cuts-up, there is more interest to investigate the chemical changes occurring in these products during chilling storage. Therefore, the aim of the present investigation was to evaluate the point at which the spoilage of chilled chicken cuts-up was begun (incipient spoilage). Thus, the chilled cuts-up were represented by chicken breasts, chicken thighs and chicken drumsticks, and examined for determination of Hydrogen ion concentration (pH), Total Volatile Basic Nitrogen (TVN) and Thiobarbituric Acid number (TBA).

2. MATERIAL AND METHODS

2.1. *Collection of samples*

A total of 15 random samples of cut-up chicken breast, thigh and drumstick (5 of each) were collected randomly from local slaughter poultry shops in Menoufiya governorate. The collected samples were transferred as rapidly as possible to the laboratory. Each sample was divided into 5 separate portions and packaged into polyethylene pockets and then stored at chilling shelves (2-5°C). All collected samples were periodically examined at

zero (the day of slaughter), 2, 4, 6 and 8 days of the refrigeration storage. The samples of different chicken cuts-up were analyzed for determination of pH, TVN and TBA to determine the critical point at which the spoilage of such food items is started (incipient spoilage).

2.2. *Chemical parameters*:

2.2.1. *Determination of pH according to Pearson* [8]:
The pH value was determined by using an electrical pH meter (Bye model 6020, USA).
2.2.2. *Determination of Total Volatile Nitrogen (TVN) (mg %)*:
The technique of Conway's test was applied (Food and Agriculture Organization "FAO" [**4**]).
2.3. *Determination of Thiobarbituric acid number (TBA) (mg %)* according to Vyncke [10] :
It was determined by using spectrophotometer at wave length 538 nm. The TBA values were recorded as mg malonaldehyde /kg sample.

3. RESULTS AND DISCUSSION

Determination of spoilage of chicken cuts-up during chilling storage is of great significance for estimation of the shelf-life of such food articles.

1. *Determination of pH*:

Results achieved in table (1) and fig (1) declared that the average pH values of the examined samples of chicken cuts-up at chilling temperature stored for zero, 2nd, 4, 6 and 8th days were 5.86 ± 0.01, 6.12±0.01, 6.59±0.01, 7.27 ± 0.01 and 8.35±0.01 for breast samples, 5.78 ± 0.01, 5.95 ± 0.01, 6.31 ± 0.01, 6.84 ± 0.01 and 7.79 ± 0.01 for thigh samples and 5.94± 0.01, 6.25± 0.01, 6.73±0.01, 7.68± 0.01 and 9.02± 0.01 for drumstick samples, respectively.
Pearson [8] stated that the incipient spoilage occurs at pH 6.2. Accordingly, the incipient spoilage was recorded at 2nd to 4th days of chilled storage for chicken breast, 4th day for chicken thigh and 2nd days for chicken drumstick as recorded in table (1).The decrease in pH value in meat may be attributed to the break down of glycogen with the formation of lactic acid and the increase in pH may be due to the partial proteolysis leading to the increase of free alkaline groups depending on the condition of such changes. Besides, higher pH values of thigh meat compared to breast meat may be due to increase of lactic acid concentration via anaerobic metabolism in breast meat [7].

Table 1 Mean values of pH in the examined samples of chicken cuts-up stored at chilling temperature (2-5°C).

Storage time (days)	Chicken cuts-up (n=15)		
	Breast	Thigh	Drumstick
0	5.86±0.01	5.78±0.01	5.94±0.01
2	6.12±0.01	5.95±0.01	6.25±0.01
4	6.59±0.01	6.31±0.01	6.73±0.01
6	7.27±0.01	6.84±0.01	7.68±0.01
8	8.35±0.01	7.79±0.01	9.02±0.01

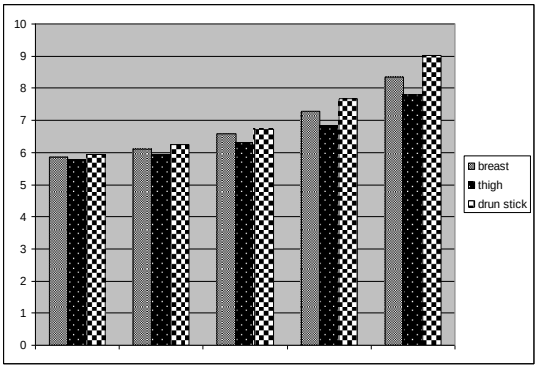

Fig 1 Mean values of pH in the examined samples of chicken cuts-up at chilling temperature (2-5°C).

The variations in the broiler breast meat color, due to pH, can be related to differences in the shelf life of the product, high muscle pH produced conditions that make it dark [2].
The differences between the examined samples of chicken cuts-up were significant ($P < 0.05$). While, the storage time had high significant ($P < 0.01$) effect on pH values of such cuts-up. In contrast,

the interaction between the types of chicken cuts-up and storage time was non-significant as shown in table (2).

Table 2 Analysis of Variance (ANOVA) of pH values in the examined samples of chicken cuts-up stored at chilling temperature (2-5°C).

Source of variance	D.F	S.S.	M.S.	F. value
Total	74	19.3293		
Bet. products (P)	2	1.1596	0.5798	3.91+
Bet. time (T)	4	8.0971	2.0243	13.65++
P x T interaction	8	1.4712	0.1839	1.24NS
Error	58	8.6014	0.1483	

D.F. = Degrees of freedom, + = Significant differences, S.S.= Sum square, ++= High significant differences, M.S. = Mean square, NS = Non significant differences

2. Determination of TVN (mg %)

The total volatile nitrogen (TVN) values was increased to critical values during chilling storage indicating incipient spoilage of these cut-up chicken meat after different periods of chilling storage.

The data recorded in table (3) and fig (2) indicated that TVN values of the examined samples of chicken cuts-up at chilling temperature stored for zero, 2, 4, 6 and 8 days were 9.74±0.28, 17.53±0.52, 31.06±0.65, 46.21±0.83 and 60.44±1.07 for chicken breast samples, 9.10±0.23, 14.86±0.39, 27.65±0.57, 39.94±0.70 and 51.25±0.79 for chicken thigh samples and 7.36±0.17, 12.91±0.33, 25.04±0.48, 34.150±.62 and 42.86±0.01 for chicken drumstick samples, respectively.

Generally the TVN value of 30 mg% represented unacceptable limit in foods [8]. Therefore, the incipient spoilage was occurred at 4th day of storage for chicken breast, 4^{th} days of storage for chicken thigh and 4^{th} -6^{th} days of storage for drumstick. Furthermore, the breast samples contained the highest level of TVN followed by thigh and drumstick. This could be attributed to the higher protein content in breast as compared with thigh and drumstick [6].

TVN can be considered as a reliable indicative measure for the quality of various food articles especially chicken meat and chicken cuts-up. In general, TVN in chicken cuts-up may be increased as the days of storage increased [9].

Table 3 Mean values of TVN (mg %) in the examined samples of chicken cuts-up stored at chilling temperature (2-5°C).

Storage time (days)	Chicken cuts-up (n=15)		
	Breast	Thigh	Drumstick
0	9.74±0.28	9.10± 0.23	7.36 ± 0.17
2	17.53±0.52	14.86±0.39	12.91±0.33
4	31.06±0.65	27.65±0.57	25.04±0.48
6	46.21±0.83	39.94±0.70	34.15±0.62
8	60.44±1.07	51.25±0.79	42.86±0.01

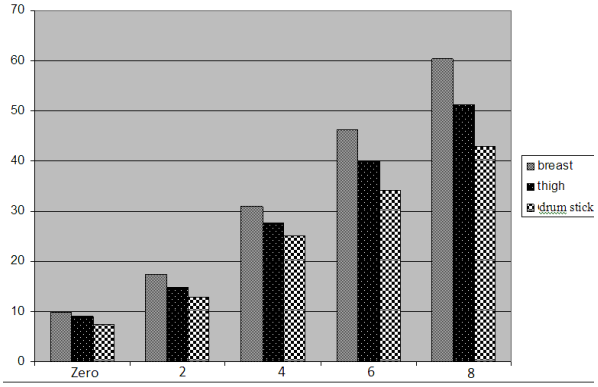

Fig 2 Values of TVN (mg %) in the examined samples of chicken cuts-up stored at chilling temperature (2-5°C).

Table (4) showed that the differences between the examined samples of chicken cuts-up meat were high significant (P <0.01).While, the storage time had high significant (P < 0.01) effect on TVN values of such products. In contrast, the interaction between the types of chicken cuts-up meat and storage time was non-significant.

Table 4 Analysis of Variance (ANOVA) of TVN values mg %) in the examined samples of chicken cuts-up stored at chilling temperature.

Source of variance	D.F	S.S.	M.S.	F. value
Total	74	586.2447		
Bet. products (P)	2	57.2143	28.6072	11.28++
Bet. time (T)	4	364.8940	91.2235	35.97++
P x T interaction	8	17.0426	2.1303	0.84NS
Error	58	147.0938	2.5361	

D.F. = Degrees of freedom, ++= High significant differences, S.S. = Sum square, NS = Non significant differences, M.S. = Mean square

3. *Thiobarbituric acid number (TBA mg %)*:

The thiobarbituric acid number (TBA) value was increased to critical values indicating incipient spoilage of these chicken cuts-up after different periods of chilling storage. The achieved data in table (5) and fig (3) showed that the average TBA values of the examined samples of chicken cuts-up at chilling temperature stored for zero, 2, 4, 6 and 8 days were 0.03±0.01, 0.38±0.01, 0.79±0.01, 0.91±0.01 and 1.06±0.01 for chicken breast samples, 0.07±0.01, 0.55±0.01, 0.92±0.01, 1.18±0.01 and 1.42±0.01 for chicken thigh samples and 0.12±0.01, 0.69±0.01, 1.14±0.01, 1.70±0.01 and 1.98±0.01 for chicken drumstick, respectively. Thus, there is direct relationship between the storage time and the TBA contents in examined chicken cuts-up.

Table 5 Mean values of TBA (mg %) in the examined samples of chicken cuts-up stored at chilling temperature (2-5°C).

Storage time (days)	Chicken cuts-up (n=15)		
	Breast	Thigh	Drumstick
0	0.07± 0.01	0.12 ± 0.01	0.12 ± 0.01
2	0.55 ± 0.01	0.69 ± 0.01	0.69 ± 0.01
4	0.92± 0.01	1.14± 0.01	1.14± 0.01
6	1.18± 0.01	1.70± 0.01	1.70± 0.01
8	1.42± 0.01	1.98± 0.01	1.98± 0.01

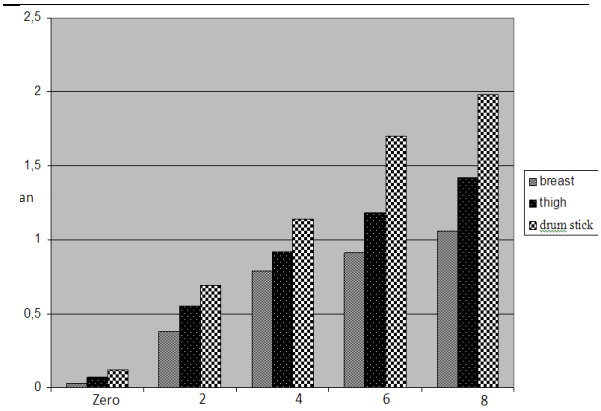

Fig 3 Mean values of TBA (mg %) in the examined samples of chicken cuts-up stored at chilling temperature (2-5°C).

Generally, the TBA values of 0.9 mg% represents unacceptable limit in foods [8]. Therefore, the incipient spoilage was occurred at 6th day for chicken breast, 4th day for chicken thigh and 2nd to 4th day for drumstick. The oxidative rancidity in fresh, frozen and cooked chicken breast and thigh meat was evaluated by measuring malonaldehyde in fat with an improved thiobarbituric acid (TBA) assay with antioxidant protection [1]. Furthermore, the drumstick contained the highest levels of TBA followed by thigh and breast. This could be attributed to the higher fat content in drumstick as compared with thigh and breast [5]. The intensity of rancidity in chicken meat during the chilling storage is accompanied by an increase in TBA value indicating extensive oxidation of fats [6]. Thus, the shelf life of chilled chicken meat products depends greatly on the TBA value. The differences between the examined samples of chicken cuts-up were highly significant (P<0.01). While, the storage time had a high significant (P<0.01) effect on TBA values of such meat. In contrast, the inter action between the types of chicken cuts-up and storage time was non-significant as shown in table 6.

Table 6 Analysis of Variance (ANOVA) of TBA values (mg %) in the examined samples of chicken cuts-up stored at chilling temperature (n=15).

Source of variance	D.F	S.S.	M.S.	F.value
Total	74	2.3362		
Between products (P)	2	0.1825	0.0913	9.72++
Between time (T)	4	1.5099	0.3775	40.16++
(P) x (T) interaction	8	0.0985	0.0123	1.31NS
Error	58	0.5451	0.0094	

*D.F. = Degrees of freedom, ++= High significant differences

Chicken cut-up meat provide to be an excellent food article prepared and considered as a good supplement of animal protein for a deficient diet.Hazard analysis critical control points (HACCP) should be applied to chicken meat plants**,** a continuous power source to provide heat, light, refrigeration and to operate

equipment, effective time-temperature control is the most important single contributor to food production. Cold storage of chicken cut-up meat in refrigeration till the due time of selling or cooking. As the chicken cut-up meat are extensively consumed, therefore, concerned authorities should take an active part in controlling such products by imposing legal regulations and specified chemical and bacteriological standards to ensure a maximum safety to consumers

5. REFERENCES

1. Abd El-Kader, Z. M. 1996. Lipid oxidation in chicken as affected by cooking and frozen storage. *Nahrung* **40**: 21-42.
2. Allen, C.D.; Russell, S.M. Fletcher, D.L. 1997. The relationship of broiler breast meat
3. color and pH to shelf- life and odor development., *Poult. Sci*. **76**:1042.
4. Ang, C. Y. 1988. Comparison of broiler tissues for oxidative changes after cooking and refrigeratin storage. *J. Food Sci*. **53**:1072-1075.
5. Food and Agriculture Organization "FAO"1980. Manual of Food Quality Control. FAO, United Nation, Rome, Italy.
6. Hassan,A. H. 2001. Studies on rancidity during cold storage of cooked poultry meat and fat.M.V. Sci., Thesis, Fac. Vet. Med., Moshtohor, Zagazig Univ., Benha branch.
7. Hassanine- Fatin, S., Hassan, M. A. 2003. Chemical indicies of incipient deterioration in chicken cut-up products. *Benha- V.M.J*. **14**: 54-65.
8. Jay, J. M. 1972. Mechanism and detection of microbial spoilage in meats at low temperature- A status report. *J. Milk Food Technol*. **35**: 467-470.
9. Pearson, D. 1984. Chemical Analysis of Foods 8th Ed, Publishing Co., Churchill Livingston, Edinburgh, London, UK.
10. 9. Reddy, S., Ilenrickson, R. l., Olson, H. C. 1970. The influence of lactic acid culryres on ground beef quality Oklahoma Agri. Experiment station, Stillwater. Oklahoma. *J. Food Sci*. **35**:787.
11. Vyncke, W. 1970. Direct determination of thiobarbituric acid value in trichloroacetic acid extracts of fish as a measure of oxidative rancidity. *Fette Seifen Anstri Climitted*. **72**: 1084-1087.
12. Zust,J., Vengust, A., Pestevsek,U., Cerne, M. 2000. Antinutritive and toxic effects of nitrites from rapeseed meal on chickens. *Krmiva*. **42**: 129-137.

مجلة بنها للعلوم الطبية البيطرية
BENHA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

دراسة على بداية الفساد في بعض قطعيات الدجاج المبردة

أبوبكر مصطفي إدريس[1]،همت مصطفي إبراهيم[1]، فهيم عزيز الدين شلتوت، محمد احمد الشاطر[2]، إيمان فتحي محمد إبراهيم[2]

[1] قسم مراقبة الأغذية، كلية الطب البيطري – جامعة بنها، [2] قسم مراقبة الأغذية– معهد بحوث صحة الحيوان بالدقي.

الملخص العربى

إن تحديد فترة صلاحية منتجات الدواجن المبردة تعتمد بدرجة كبيرة على التغيرات الكيميائية التى تحدث أثناء التخزين وعلى إستخدام طرق دقيقة للكشف على بداية تلك التغيرات لذلك أجريت هذه الدراسة. تم تجميع 15 عينة عشوائية من قطعيات الدجاج المذبوح بواقع 5 عينات من كل من صدور الدجاج، الأوراك والدبوس من محلات بيع الدجاج المذبوح من محافظة المنوفية وفحصها كيميائيا أثناء تخزينها بالثلاجة عند درجة (2–5م) وقد تم فحص العينات في اليوم الأول من الذبح، الثانى، الرابع، السادس والثامن على التوالى لتحديد فترة صلاحيتها وفى أى يوم بدأ الفساد لكل منتج وتحديد مدي دقة التجارب الكيميائية لمعرفة هذا الفساد. أ) متوسط تركيز أيون الهيدروجين: كانت نسبة تركيز أيون الهيدروجين للحوم الدجاج المبرد فى اليوم الأول، الثانى، الرابع، السادس والثامن تتزايد بزيادة فترة التخزين فى صدور الدجاج، حيث أن بداية الفساد كانت ما بين اليوم الثانى والرابع من التخزين، أما بالنسبة لأوراك الدجاج المخزن بالبرودة فقد بدأ الفساد فى اليوم الرابع، وقد بدأ الفساد في اليوم الثاني لدبوس الدجاج المخزن بالتبريد. ب) متوسط تركيز النيتروجين القلوى المتصاعد: كانت نسبة المتوسطات تتزايد بزيادة فترة التخزين بالتبريد حتى بدأ الفساد فى اليوم الرابع بالنسبة لصدور الدجاج، ما بين اليوم الرابع والسادس بالنسبة لأوراك وفى اليوم السادس بالنسبة للدبوس ومن هنا يتبين أن صدور الدجاج كانت الأسرع فى الفساد وذلك لإحتوائها على نسبة عالية من البروتين. جـ) متوسط حمض الثيوباربيتيورك (مج/كجم مالونالدهيد) أوضحت النتائج أن نسب المتوسطات تتزايد بزيادة فترة التخزين بالتبريد حتى وصلت إلى قيم حرجة يستدل منها على بداية حدوث الفساد، فى اليوم السادس لصدور الدجاج، اليوم الرابع لأوراك الدجاج وما بين اليوم الثانى والرابع لدبوس الدجاج وذلك لإحتواء الدبوس على نسبة عالية من الدهون فقد كان هو الأسرع فى الفساد. ومن ذلك يتبين أهمية الفحص الكيميائى لقطعيات الدواجن لتحديد بداية الفساد بها للحكم على جودتها وذلك للحصول على منتجات آمنة والحفاظ على صحة وسلامة المستهلك.

(مجلة بنها للعلوم الطبية البيطرية: عدد 23 (1)، يونيو 2012: 86–81)