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SENSORY, CHEMICAL AND BACTERIOLOGICAL ASSESSMENT OF CHILLED LOCAL CHICKEN DURING THE LABELED SHELF LIFE

(With 8 Figures)

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التقييم الحسى والكيميائى والبكتيرى للدواجن المبردة المحلية أثناء فترات الصلاحية المدونة

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أجريت هذه الدراسة لتقيم فترات الصلاحية للدواجن خلال فترة التخزين باستخدام التبريد عند درجات ٤°م، ٧°م و ١٠°م، ولمدة ٢، ٤ ، ٧و١٠ أيام أعتمادا على التقييم البيكتريولـوجى، الكميائى والحسى. سجلت التجارب البكتريولوجية أرتفاع فى العد الأولى للميكروبات (العـد البكتيرى الكلى للميكروبات الهوائية والميكروبات المحبة للبرودة والعدد الإحتمـالى الكلـى للميكروب القولونى والميكروب المكور العنقودى الذهبى والفطريات والخمائر). أثناء فتـرة الحفظ بالتبريد عند عشرة درجة مئوية كان هناك زيادة مطردة فى العد البكتيرى تبعه العـد بالعينات المحفوظة عند سبعة درجة مئوية فى حين أن الحفظ عند درجة ٤مئوية أوقف تكاثر الميكروبات القولونيه كما أبطأ معدل الزيادة فى العد البكتيرى وأطال فترة الصلاحية للعينات لأربعة أيام من الحفظ. كان هناك تغير طفيـف فـى نسـبه الأس الهيـدروجينى ومعـدل النيتروجين المتصاعد ولكنه ظل فى الحدود المسموح بها حتى نهاية التجربة مما يرجح عدم الإعتماد على هذه الإختبارات لتحديد كفاءة اختبارات فترة الصلاحية، من ناحيه أخرى ظـل مستوى حمض الثيوباربتيورك مقبول (٠,٩مالونالدهيد/كجم) لمدة سـبعة، أربعـة ويـومين للعينات المبردة عند ٤ °م، ٧°م و ١٠°م على التوالى. أظهرت نتائج الإختبار الحسى للرائحة أن جميع العينات حصلت على درجات قبول عالية للرائحة من المحكمين فى الأربـع ايـام الأولى. بينما العينات المبردة عند ٧°م و١٠°م كانت غير مقبولة بعد ستة وأربعة أيام علـى التوالى، فى حين أن العينات المبردة عند ٤°م ظلت مقبولة حتى انهاء فتره التجربة.

SUMMARY

The present study was conducted to evaluate the shelf-life of chicken carcasses during refrigeration at 4°C, 7°C and 10°C for 2, 4, 7, and 10 days storage depending on bacteriological, chemical and sensory assessments. Bacteriological examinations recorded high initial bacterial counts (Aerobic Plate Count, psychrotrophs, Most Probable Number of coliforms, *Staphylococcus aureus* and yeast and moulds). During refrigeration period at 10°C, there was a dramatically increase in

bacterial counts followed by samples stored at 7°C. While storage at 4°C could slow the increase rate of bacterial counts and extended the shelf-life of samples for 4 days. There was a slight change in the pH values and the Total Volatile Basic Nitrogen (TVB-N) during the experiment time and still within the permissible limit to indicate that pH and TVB-N can't be depended on the efficiency of evaluating the shelf-life of chilled chicken. On the other hand, Thiobarbituric Acid (TBA) values were undergo the acceptable limit (0.9 mg malonaldehyde/kg) for 7, 4 and 2 days for the chicken samples stored at 4°C, 7°C and 10°C respectively. All samples reserved high acceptable odor score during the first 4 days of refrigeration storage. After this period samples stored at 7°C and 10°C were unaccepted after 6 and 4 days respectively, while at 4°C storage samples stayed accepted within time span of the experiment.

Key words: *Poultry meat, shelflife, APC, psychrotrophs, coliforms, S.aureus, fungi*

INTRODUCTION

Poultry meat comprises a substantial protein of Egyptian diet. Because poultry meat is generally purchased in fresh refrigerated form, the quality (including the microbiological quality) of chicken purchased in retail markets is concern for suppliers, consumers and public health official world wide.

Chilled chicken meat has a relatively short shelf life even under good storage conditions, and the initial bacterial load is greatly influence the shelf life of broilers (Arafa and Chen, 1977; Cunningham, 1979). The slaughtering and dressing of broilers involve several different processes which influence the bacterial load of the carcasses (Sauter *et al.*, 1968; Notermans *et al.*, 1977).

Aerobic plate count, psychrotrophs, coliforms, *Staphylococcus aureus* and yeast and moulds have been used in meat and poultry products to assess their microbiological safety, sanitation condition throughout processing, and keeping quality (Tompkin, 1983; Lillard *et al.*, 1984).

Aerobic plate count has been used as a criterion for predicting shelf life and assessing the hygiene of poultry processing plants (Lillard *et al.*, 1984).

Psychrotropic bacteria can originate from the feathers and the fet of the birds, the water supply and the equipments in the processing plant. Psychrotrophic plate counts have been used as a general indicator of potential shelf life of fresh chicken (Russell, 1997).

Coliforms have been, and still are used as indicators of possible faecal contamination, hence, the possibility that pathogenic organisms may also be present (Speck, 1984).

S. aureus is important in relation to poultry meat hygiene because of its ability to produce enterotoxins which may cause food poisoning in human beings. Staphylococcal food poisoning is one of the major cause of food borne illness throughout the world. *S. aureus* is a normal flora of live poultry; however it doesn't grow very well under refrigeration temperatures in poultry meat and its presence at high levels is generally due to extremely high storage temperatures (Waldroup, 1996; Jablonski and Bohach, 1997).

Yeast have been isolated from the surface and environment that surround the chicken both in the poultry brooding and rearing houses, in the transport cages, and in the slaughter house (Vorster *et al.*, 1994). Barnes *et al.*, (1978) has been reported a large increase in the numbers and proportions of yeasts on spoiled chilled poultry carcasses under certain conditions.

Spoilage is commonly detected by sensory and/or microbiological analysis. A disadvantage of the former often requires trained panelists to minimize subjectivity. Whereas the latter is laborious, time consuming and requires extensive knowledge of specific spoilage organisms. An alternative method to the above mentioned analyses involves the measurement of chemical changes associated with the growth of specific organisms in poultry meat (Dainty, 1996). Among these changes, lactates, glucose, degree of lipid oxidation and biogenic amines have been proposed as potential indicators of spoilage (De Azevedo *et al.*, 2003; Patsias *et al.*, 2006).

Thus, the aim of the present work was carried out to assess the microbiological, chemical and sensory quality of whole chicken carcasses stored under different chilling storage temperatures.

MATERIALS and METHODS

Sampling:

Twenty six whole fresh broiler chicken carcasses were collected from chicken retail shops (poultry's shops) and individually packed in polyethylene bags. The samples were transferred in an ice box to the laboratory.

Two carcasses were subjected to microbiological and chemical analysis before storage and the average counts and results were regarded

as the initial (0 time). Carcasses were divided into three groups and stored at 4°C, 7°C and 10°C. After various periods of storage (2^{nd}, 4^{th}, 7^{th} and 10^{th} days) two carcasses were withdrawn periodically from each group for the following analysis.

1- Microbiological analysis:

According to the method obtained by APHA (1992) twenty five gm of breast skin were removed from each carcass and were blended in a stomacher for 2 minutes in 225 ml of 0.1% (wt/vol) peptone water. Decimal dilutions were carried out using the same diluents. The spread plate technique was used to prepare two replicate plates for the determination of the following:

- Aerobic Plate Count (APC) using Plate Count agar incubated at 37°C for 24 hours.
- Psychrotrophic counts using Plate Count agar at 7°C for 10 days.
- Total coliform counts (MPN) using Lauryl Sulphate Tryptose broth incubated at 37°C for 48 hours.
- *Staphylococcus aureus* count using Baird-Parker agar incubated at 37°C for 48 hours.
- Yeast and moulds counts using Sabaroud Dextrose agar incubated at 25°C for 5 days.

2-Chemical analysis:

The samples of each group were also subjected to the following chemical examination: pH value was determined according to AOAC (1990) using pH meter (Digital, Jenco 609). Determination of Total Volatile Basic-Nitrogen was carried out according to FAO (1980), while Thiobarbituric Acid (TBA) value was determined according to Tarlagis *et al.*, (1960) and Pikul *et al.*, (1983).

3-Sensory analysis:

A panel of seven panelists was used for sensory analysis. Panelists were asked to evaluate odor intensities of chilled chicken samples. Acceptability as a composite of odor was estimated using a descriptive scale ranging from 1-9, where: a score of 6 was taken as the lower limit of acceptability (Boerema *et al.*, 1993; Penney *et al.*, 1993). The product was defined as unacceptable after development of first off-odor as scored by at least 50% of the judges.

The average results of this study were obtained from three replicates.

RESULTS

Fig. (1) Aerobic Plate Count

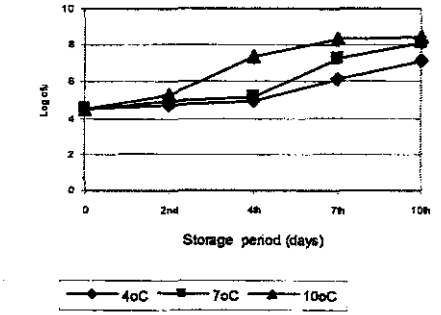


Fig. (2) Psychrotrophoc count

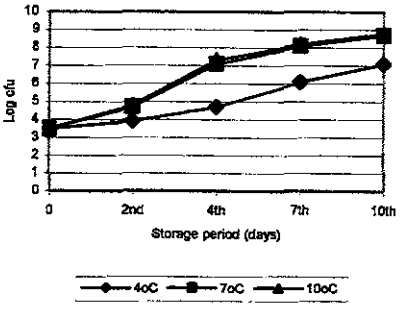


Fig. (3) *S. aureus* count

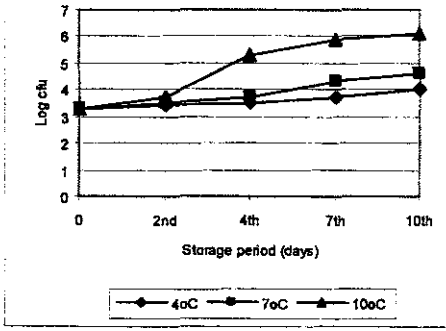


Fig. (4) Coliforms (MPN)

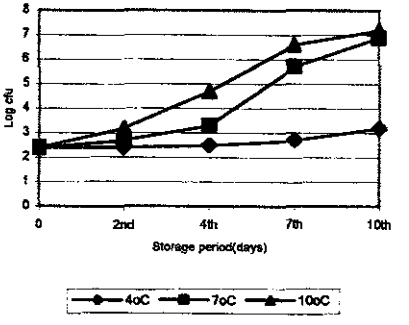


Fig. (5) Yeast and moulds count

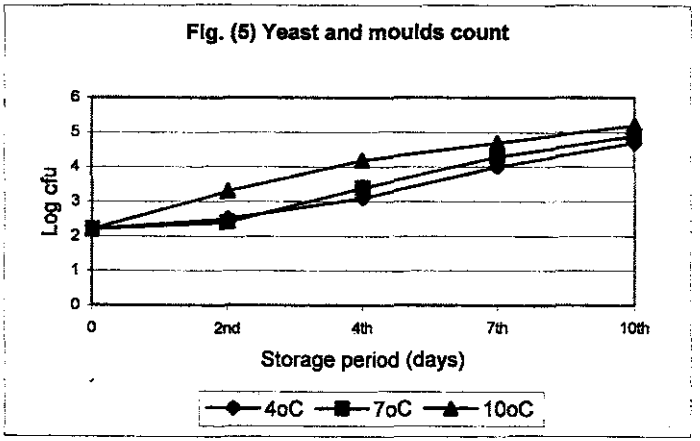


Fig. (6) TBA values

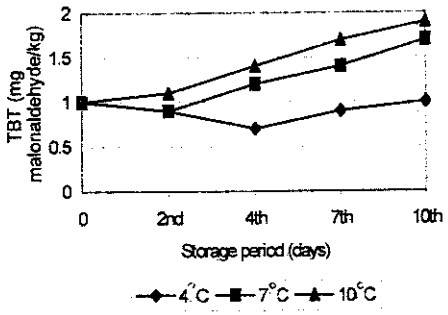


Fig. (7) TVB-N

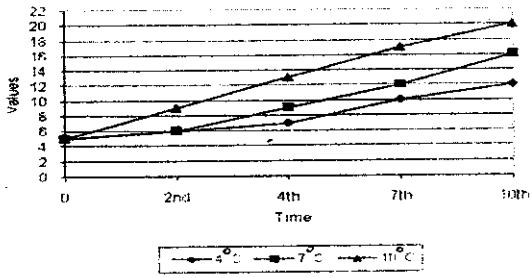
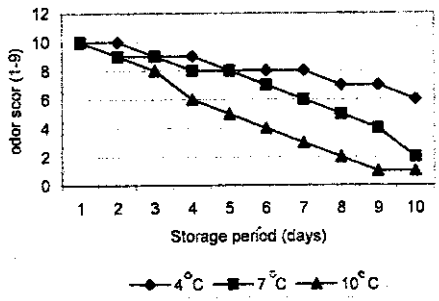


Fig. (8) Sensory evaluation



DISCUSSION

The average initial APC count at the beginning of the storage (0 day) was 4.51 log cfu/gm (Fig. 1). Fresh broilers can be expected to have initial counts of 10^4 to 10^5 cfu/cm^2 (Walker and Ayres, 1956; Brune and Cunningham, 1971). The present results were nearly similar to that obtained by Bailey *et al.*, (2000) and Patsias *et al.*, (2006). In this study Aerobic Plate Count reached 7 log cfu on day 10th, 7th and 4th of storage at 4°C, 7°C and 10°C respectively and it was considered as maximum acceptability limit for fresh poultry meat as defined by ICMSF (1986). Capita *et al.*, (2001) and Patsias (2006) have been shown that the initial microbial count affect shelf life of chilled poultry.

The average initial count of psychrotrophic microorganisms was 3.5 log cfu/gm and it had been increased throughout the study (Fig. 2). Results showed that the average growth level increased dramatically after 4 days of storage at 4°C and recorded high level of growth after 2 days of storage at both 7°C and 10°C. These results were coincided with

the finding obtained by Sofos (1994). In contrast our results were lower than those obtained by Bailey *et al.* (2000).

Fig.(3) shows the average *S. aureus* initial count (3.3 log cfu) and it was slightly higher than those mentioned by Sofos (1994) who showed that the level of this microorganism is 3 log cfu. The present results, Also, indicates that, the mean *S. aureus* counts were relatively high during storage after day 2 while, it slightly increased during storage at 7°C until day 6 and it were nearly constant throughout 10 days at 4°C.

S. aureus counts obtained in the U.S Nationwide Broiler Chicken Microbiological Baseline Data Collection Program (1996) were also quite variable, and values from 0 to 3 log cfu were obtained. The recorded results indicated that *S. aureus* counts were relatively high during storage at 7°C and 10°C, while it didn't increased during storage at 4°C.

Coliform bacteria usually gain access to chicken meat during evisceration, as they constitute part of the normal intestinal flora of poultry (Notermans *et al.*, 1980). Mean log values of coliform growth were relatively constant during storage at 4°C until 7 days of storage. At 7°C growth took place at reasonable rate, especially at till 4 days of storage, while, samples stored at 10°C, coliform counts showed speedily increase starting after the 2nd day of storage. However, the chilled samples reached the unacceptable limit of coliform count during storage at 4, 7 and 10°C after 2 days of storage (Fig. 4). Nearly similar results were obtained by Barnes and Impey (1974); Russel (1997) and Bailey *et al.* (2000). However, Russell *et al.* (1995) concluded that low level temperature abuse may be detected by monitoring population of coliform and it could be reduced significantly by refrigeration at 3°C.

The average initial yeast and mold counts were 2.2 log cfu (Fig. 5). This finding was higher than that obtained by Gardner and Golan (1976) and Izat *et al.* (1989). Nearly similar contaminant levels were obtained by Viljoen *et al.* (1998). The mean (log cfu) of yeast and moulds count showed an increase in samples stored at 4°C and 7°C till day 7 while, it highly increased during the period of storage at 10°C. The similarity between psychrotrophic and yeasts and moulds counts suggests that psychrotrophic yeast and moulds represented a reasonably high proportion of this group.

Viljoen *et al.* (1998) and Patsias *et al.* (2006) showed that yeast and moulds made a significant contribution to the overall microbial ecology of poultry, and it may be possible that yeast also contribute to the changes leading to spoilage.

Generally, the carcasses stored at a temperature around 4°C hindered the multiplication of bad competitor microorganism. However maintaining cold temperature is not generally controlled to the same degree (for the same period of storage time) the carcasses are kept at relatively high temperature which in turn could allow for the multiplication of mesophilic microorganisma such as *S. aureus* (Capita *et al.*, 2001).

Results of TBA values remained lower than or equal 1 mg malonaldehyde/kg during the entire storage period for samples that held at 4°C (Fig. 6). These results were coincided by the finding recorded by Patsias *et al.* (2006) and Blamatsia *et al.* (2006). While it reached this value after 4 and 2 days for samples that held at 7°C and 10°C respectively. It is clear that the onset of increase in TBA values after these periods of storage coincided with the starting of spoilage.

Among the chemical indicators of spoilage, Thiobarbituric Acid (TBA) value, which of the degradation products of lipid hydroperoxide formed through oxidation of Unsaturated Fatty Acids (UFA) (Nawar, 1996).

Regarded to Total Volatile Basic Nitrogen (TVB-N) values for samples stored at 4°C were far lower than the permissible limits recommended by Egyptian Standard Specification (1651-2005) throughout the storage period (12 mg N/100g). While it was increased steeply with value of 20 mg/100g for samples stored at both 7 and 10°C till the end of the experiment. These results were nearly similar to the results obtained by Patsias *et al.* (2006) and Balamatsia *et al.* (2006). Spoilage occurs when the carbohydrate source in a growth medium is exhausted by the bacteria. Once the carbohydrate supply is depleted, spoilage bacteria, such as the Pseudomonas, begin to utilize other sources of energy which produce odoriferous end-products (Pooni and Mead, 1984). These facts may explain why pH values showed little change (5.9-6.2) during the storage period of the present study.

The results of the sensory evaluation (odor) of chilled chicken carcasses stored at 4°C, 7°C and 10°C for 10 days are presented in Fig. (9). Chicken carcasses samples stored at 4° received higher overall acceptability scores than samples stored at 7°C and 10°C up to 10 days. Off-odors are produced when the population of spoilage bacteria reaches between 5.2 to 8.0 $\log_{10}$ cfu/cm^2 (Elliott and Michner, 1961). Also, all chicken samples received high odor scores during the first 4 days while, after this period, temperature storage degree affected the odor acceptability. Samples stored at 4°C never reached the unacceptability

limit (score 6) within time span of the experiment, while, samples stored at 7°C and 10°C reached that limit after 6 and 4 days respectively as shown in Fig. (9). The obtained results were nearly as that recorded by Gallo *et al.* (1988) and Patsias *et al.* (2006).

In conclusion, the initial bacterial counts of fresh chicken have been to affect shelf-life of chilled poultry. Furthermore, results indicated that an appropriate chilling storage that can maintain a desirable odor and chemical properties offer no guarantee with respect to microbial profile. Also, the present study revealed that when processed chicken is held at a common refrigerator temperature, the bacterial count will increase, thus significantly reducing shelf-life. However, it would be necessary to make sure that all carcasses submitted to chilling were cooled to temperature less than 4°C as quickly as possible and kept refrigerated at this temperature until subjected to adequate heat treatment to kill all potentially dangerous bacteria which may have survived the refrigeration. In addition other factors that affect shelf-life including scalding temperature, treatment with chlorine, preservatives such as sorbic acid and packaging must be put into consideration. Methods for reducing carcasses contamination to produce safer products with an extended shelf-life deserve further study.

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