



## THE CORRELATION BETWEEN pH AND MICROBIAL SPOILAGE OF MINCED MEAT DURING REFRIGERATION

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### ABSTRACT

In this study, thirty samples of minced red meat were randomly purchased from Baghdad markets and held in the refrigerator at  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ . Data of pH values, sensory and microbiological analysis were taken at the 1st, 2nd, 3rd, 4th, 5th, and 7th days of storage. The mean values of total bacterial counts and the pH values of the samples tested were increased significantly ( $p < 0.05$ ) as the incubation time at the refrigeration temperature  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$  progressed. A positive correlation was obtained between the mean values of total bacterial counts and pH mean values. The results of this study revealed that the meat color was changed from bright-red to pale-red to dark-red at the third and fourth day (-ve correlation), but no off-odour was observed in most of the samples until the fourth day of storage when the mean  $\log_{10}\text{cfu/g}$  was 6.78, and the mean pH values was 6.16, then at the fifth day the majority of the samples tested revealed dark-red to brown coloration with off-odours when the mean  $\log_{10}\text{cfu/g}$  exceeded 7.5, and their pH mean value was 6.39. These results revealed that there was a significant correlation ( $P < 0.05$ ) between minced red meat pH and spoilage degree, accordingly pH measurement can be used for microbial quality assessment of minced meat stored under chilling aerobic conditions.

**KEYWORDS:** red meat, Baghdad markets, microbiological analysis, pH.

### INTRODUCTION

Meat and meat products are considered the most vital parts of nutritious diet, and very essential for growth, compensation and maintenance activities of the human body because of their high values of proteins and vitamins specially vitamin B. Because of their biological and chemical compositions, they are highly perishable foods and are very good medium for the growth of many hazardous bacteria (mesophilic and psychrophilic bacteria) which can cause human infections, meat spoilage, and economic losses (Kalalou *et al.*, 2004). Food safety has a top priority for the food service organizations, and many different food items have been recalled from the markets due to wide illness outbreaks caused by the growth of bacteria, and ground meat was among these recalled items (Sotos, 2008). Several factors can affect microbial spoilage of meat, where both the pH and temperature are among these factors (Koutsoumanis *et al.*, 2006). Colour of meat is the first impression to the consumer and indicates the meat freshness or meat spoilage while the other sensory evaluations, like meat odour, come next. The pH of fresh meats are generally within the range of 5.5 to 5.9, and off odour may become evident when the level of bacterial count per gram reaches  $1 \times 10^7$  and when they reaches  $1 \times 10^8$  per gram, off odours become recognizable, leading to evident sensory spoilage (Jackson *et al.*, 1997 and Stanbridge *et al.*, 1998). Meat freshness and meat safety are considered generally as the most important parameters for the consumers and food industries, and is of very importance

to establish rapid methods for microbial spoilage detection of meat, the ideal methods must be rapid (not time consuming), not laborious, not destructive, quantitative, relatively inexpensive, reagentless, and accurate. At the present time there are several methods to assess meat microbial spoilage, but each has some disadvantages, measuring of meat pH to assess meat spoilage may have little disadvantages because it takes very little time, not destructive, reagent less, not laborious, and can be easily used in meat industries and slaughterhouses, accordingly measuring the pH values of meat are used in the international meat trade to assess meat spoilage (Anon, 1982).

### MATERIALS & METHODS

Thirty samples of minced red meat with very little or no fat were randomly purchased from Baghdad markets weighing approximately 500 grams, each sample was placed separately in identified sterile plastic bag, then transported to meat hygiene laboratory, (College of Veterinary Medicine, Baghdad University) within one hour. Each sample aseptically blended for three minutes, then portioned into six representative portions in sterile thoroughly identified bags (subsamples), all samples were stored in the refrigerator at chilling temperature  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ . The bacteriological examinations, pH measurements, and the sensory evaluations of the samples were done at the 1st, 2nd, 3rd, 4th, 5th, and 7th days of chilling storage.

**Bacteriology**

The samples were thoroughly blended, 25 grams from each sample were aseptically added to 225 ml of sterile peptone saline 0.1% w/v, homogenized by using stomacher for 2 minutes, then serial decimal dilutions were prepared by adding one ml of the homogenate to nine ml of peptone saline 0.1% w/v and then from each appropriate dilution one ml was taken and spreaded onto duplicate previously prepared plate count agar (Diffco, U.S.A.), and the petri dishes then incubated at 32°C for 48 hrs. (Berruga *et al.*, 2005).

**pH measurement**

Portable compact electronic battery driven pH meter (Hanna instrument) was used to measure the meat pH following the microbial analysis of the sample by immersing the tip of the glass electrode in the drip of the minced meat sample and reading pH value.

The pH meter was calibrated periodically according to the manufacturers guiding by using buffer solution pH 7.0 and pH 4.0 and adjusted with the temperature of the samples.

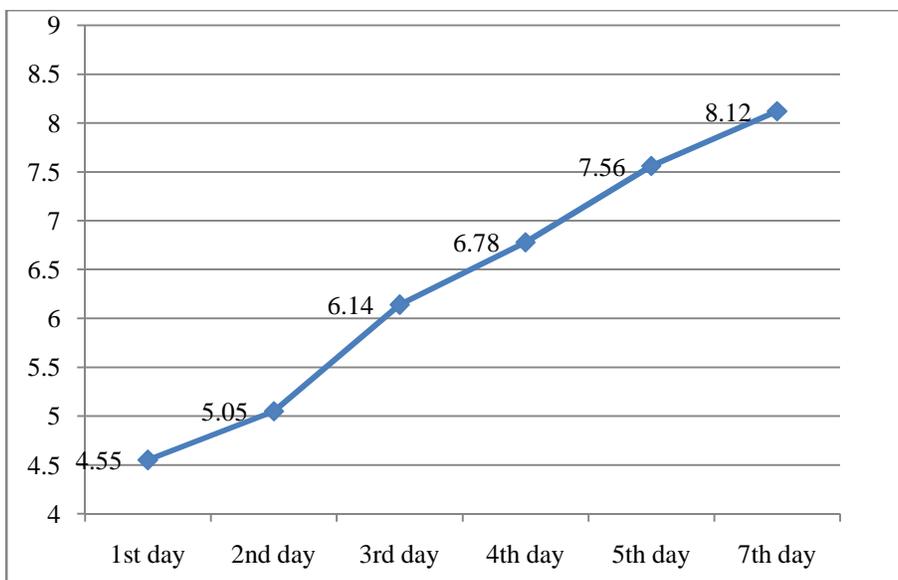
**Sensory evaluation**

According to Gill and Jeremiah, (1991) colours and odours evaluation were performed after bacteriological examination and pH measurement of the samples by a sensory panel, consisted of five trained meat laboratory staff members, each one of them was participated blindly in each sample evaluation. Samples of minced meat were delivered to the panelists in randomly identified covered Petri-dishes. Colour evaluation was carried out by artificial light, and the

temperature of the sample resembles the ambient temperature, while odour evaluation was carried out before and after sample cooking. The hedonic scales used were 3, 2.5, 2, 1.5, and 1, where the score 3 refers to typically fresh minced meat, score 2 refers to marginal level between acceptability and unacceptability, score 1 refers to unacceptable samples (spoiled samples), and score 2.5 refers to semi-fresh samples which was the first signs of changes from typical freshness.

**RESULTS & DISCUSSION**

The mean values of total bacterial counts in the samples tested were increased significantly ( $p < 0.05$ ) as the incubation time at the refrigeration temperature  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$  progressed, and their mean  $\log_{10}\text{cfu/g}$  were 4.55, 5.05, 6.14, 6.78, 7.56, and 8.12 at the 1st, 2nd, 3rd, 4th, 5th, 7th days of incubation respectively as shown in Fig 1, and their mean pH values were 5.50, 5.65, 5.88, 6.16, 6.39, and 6.65, respectively as shown in Fig 2, whereas a positive correlation was obtained between the mean values of total bacterial counts and pH as shown in Fig 3. The obtained bacterial  $\log_{10}\text{cfu/gm}$  values were lower than values recorded by Mohamed *et al.* (2014). The results of the sensory evaluation of tested samples revealed that the colours acceptability were 2.83, 2.70, 2.70, 1.80, 1.60, and 1.17, whereas the odours acceptability were 2.87, 2.77, 2.50, 1.93, 1.57, and 1.10, at the 1st, 2nd, 3rd, 4th, 5th, and 7th days of incubation respectively ( Fig. 4 and Fig. 5 ).



**FIGURE 1:-** Total bacterial counts mean curve  $\log_{10}\text{cfu/g}$  of minced red meat during refrigeration storage at  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

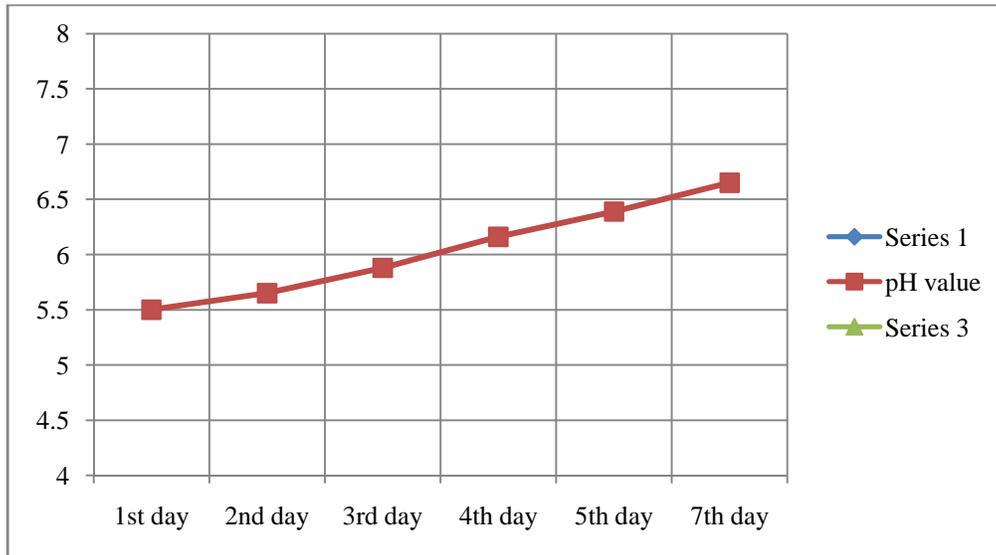
The results of this study revealed that the total bacterial counts (mean  $\log_{10}\text{cfu/gm.}$ ) increased progressively nearby with refrigeration storage time at  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$  and the colour changed from bright-red to pale-red to dark-red at the third and fourth day (-ve correlation), but no off-odour was observed in most of the samples until the fourth day of storage when the mean  $\log_{10}\text{cfu/g}$  was 6.78, and the mean

pH values at that day was 6.16, then at the fifth day the majority of the samples tested revealed dark-red to brown colouration with off-odours when the mean  $\log_{10}\text{cfu/g}$  exceeded 7.5, and their pH mean value was 6.39 and these results were in agreement with Korkeala *et al.* (1988), whereas a bacterial value of 7  $\log_{10}\text{cfu/g}$  was considered as the maximum limit for TVC of minced red meat with good

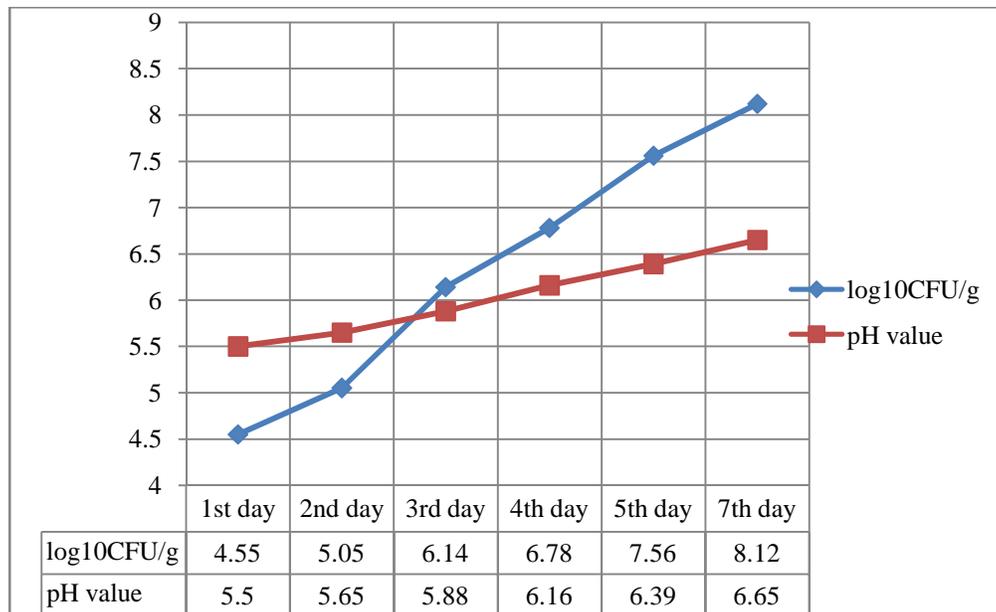
quality as described by (ICMSF 1986). Storage time caused gradual rise in meat pH and this was in agreement with Doherty *et al.* (1996) and Jayesh *et al.* (2000) and these results were lower than the results recorded by Mäkelä *et al.* (1990).

The gradual but harmonious rise in meat pH (meat alkalinity) as storage time and spoilage progressed could be attributed to the tissue breakdown and odoriferous nitrogenous compounds production, among them ammonia

was the most prevalent (Stanbridge, 1998, and Dainty *et al.*, 1985.). The results of this study revealed that there was a significant correlation ( $P < 0.05$ ) between minced meat pH and spoilage degree, for that, pH measurement can be used as effective tool for microbial quality assessment of minced meat stored under chilling aerobic conditions, and preferably, the combination of pH measurements with sensory evaluations can assess more accurately for minced meat spoilage.

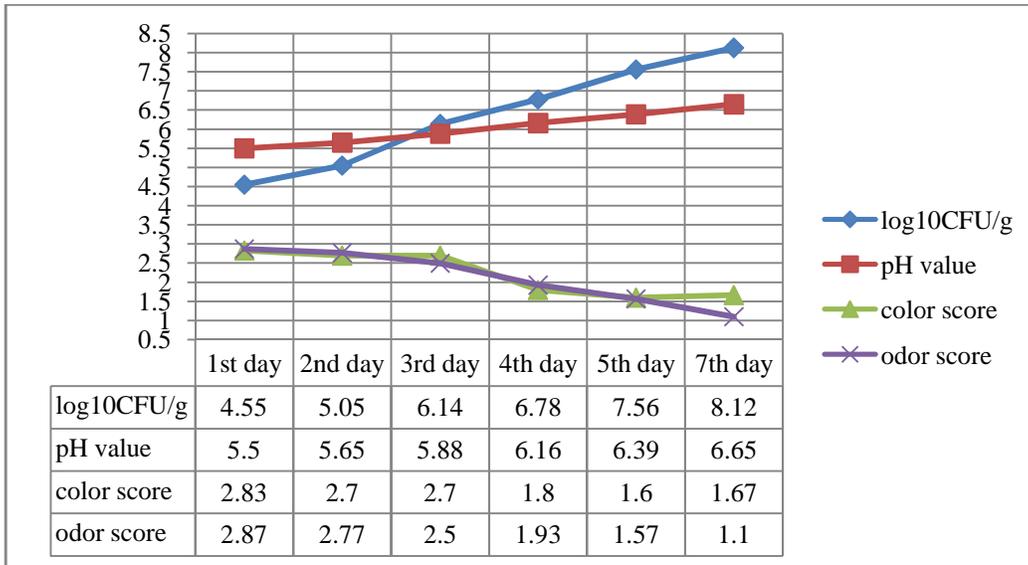


**FIGURE 2:** pH values means of minced red meat during refrigeration storage at  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

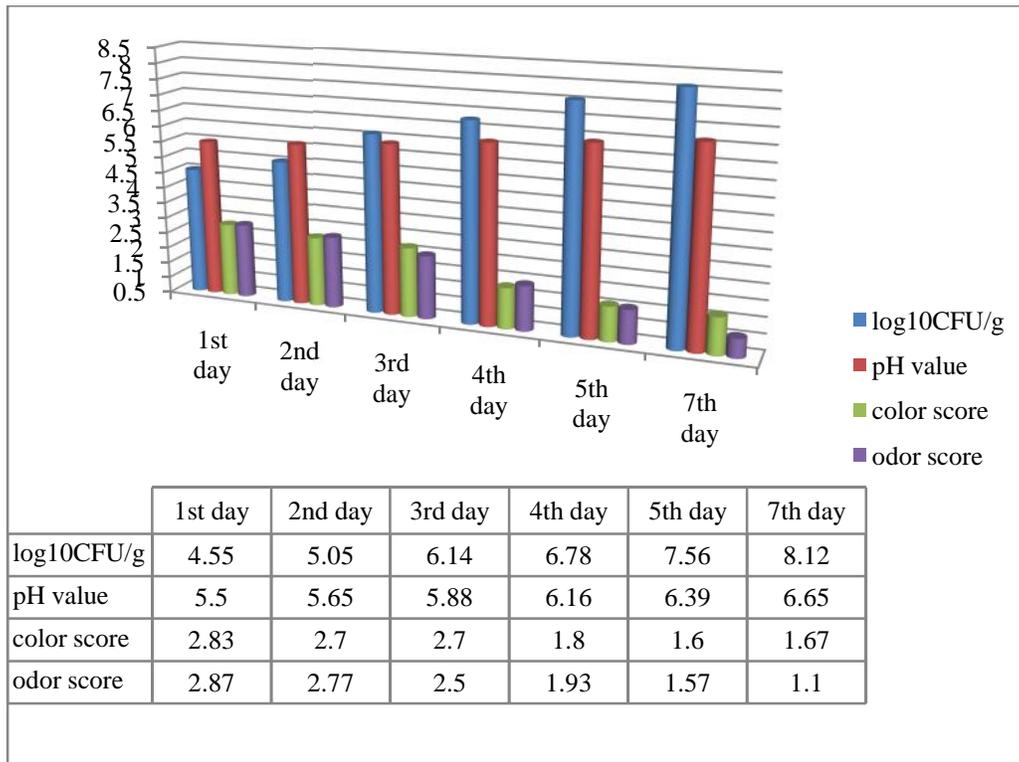


**FIGURE 3:** Total bacterial counts means in relation with pH values means of minced red meat during refrigeration storage at  $4^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

PH and microbial spoilage of minced meat during refrigeration



**FIGURE 4:** Relationship between pH, log10cfu/g, colour and odour scores mean values of minced red meat during refrigeration storage at 4°C ±1°C.



**FIGURE 5:** relationship between mean values of pH, log10cfu/gm, colour scores and odour scores of red minced meat during refrigeration storage at 4°C±1°C.

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