

EFFECT OF ANTIMICROBIAL AGENTS ON SOME CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF VACUUM - PACKAGED GROUND BUFFALO MEAT STORED UNDER REFRIGERATED CONDITION

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Abstract: The chemical characteristics and microbiological examination of vacuum packaged ground buffalo meat during cold storage for 24 days were determined in order to evaluate two different antimicrobial agents sodium lactate, sodium chloride and their mixture. The results indicated that the use of sodium lactate with or without sodium chloride delayed the proliferation of aerobic plate count, psychrotrophic count, and lactic acid bacterial count, and extended the shelf life up to more than 24 and 21 days respectively, compared to 8 days for the control samples. The TBA values for the samples treated by sodium chloride was not affected, while at the end of storage period the TBA values of samples treated by sodium lactate were significantly reduce the oxidation changes. Therefore, the use of sodium lactate with or without sodium chloride could be used to extend the shelf life of ground buffalo meat during refrigerated storage by reducing both chemical and microbiological changes.

Key words: buffalo meat, antimicrobial agents, chemical and microbiological characteristics

Introduction

In some Middle Eastern, African, and Asian countries, most of carcasses are commonly marketed at refrigerated condition. However, many undesirable changes can be occurred during storage time as a result of microbial growth and /or lipid oxidation resulted in quality reduction and economical loss.

While general cleanliness and proper sanitation are very effective, other means of controlling microbial growth in meat may be prove useful. Minimizing contamination and delaying or inhibiting growth of spoilage organisms are major

keys for improving fresh meat shelf life and increasing consumer safety. *Bedie et al., 2001* reported that lactates have been permitted as a natural preservative at a level up to 3 g/100g meat by the USDA-Food Safety and Inspection Service (USDA-FSIS). Much research indicated that addition of sodium lactate (NaL) could improve flavor, color, tenderness, juiciness, and cooking yield of ground beef and other meat products (*Eckert et al., 1997; Maca et al., 1997; and Vote et al., 2000*).

Sodium lactate (NaL) has an antimicrobial effect. It has been shown to delay growth of meat spoilage organisms (*Brewer et al., 1995; Maca et al., 1999; Mbandi and Shelef, 2001; and Vasavada et al., 2003*). Moreover, other authors reported that NaL has inhibitory effect on lipid oxidation (*Walczycka et al., 1999*).

Samejima and Sallam (2004), reported that the use of NaL in combination with sodium chloride (NaCl) reduced the microbial growth, maintained the chemical quality and extended the shelf life of ground beef during refrigerated storage.

Sodium chloride has been long used as a meat preservative. It is added to meats for its effect on sensory, functional and preservation. It inhibits the microbial growth by restriction of the free water in the meat products. However, its pro-oxidant activity accelerates the development of lipid oxidation in refrigerated meats (*Rhee, 1988; and Lee et al., 1997*). It had been reported that lactate reduced the pro-oxidant effect of NaCl in refrigerated and frozen meat products (*Tan and Shelef, 2002*).

Since storage of meats under low temperature causes dehydration as a result of moisture losses and temperature fluctuations, the protection of refrigerated and frozen met against fluctuations in temperature during storage is important from the stand point of quality retention (*Kenawi, 1994*). An obvious approach is the use of suitable packaging materials to meet various criteria, such as protection against moisture migration and mechanical damage. The objective of this investigation was to study the effect of two antimicrobial agents' sodium lactate and sodium chloride or their combination on some chemical and microbiological quality of vacuum-packaged ground buffalo meat stored under refrigerated condition.

Materials and methods

Samples:

The buffalo meat used in this study was obtained from the local market in El-Minia, Egypt, one hour after slaughter. The sample was trimmed and hold at 4°C for 24 hours and then ground. The ground sample then divided into four groups. One group was left as control, while the others were treated by (3% W/W) NaL, (3% W/W) NaCl, and (4%W/W) mixture of NaL and NaCl, respectively. Each

sample was thoroughly mixed by hand and reground through a 3mm grinder plate, then divided into 100g samples and vacuum packaged in a 3 mil laminated polyethylene/nylon bags, then stored at refrigerated condition (24 days) for investigation.

pH measurement:

A slurry was prepared by blending the meat (5g/50ml distilled water). The pH of this slurry was measured by using the glass-electrode method according to the AOAC method (1975).

Thiobarbituric acid (TBA) value:

Treated and un treated vacuum packaged samples were tested separately in duplicate according to the method of Harold et al., (1981). Colorimetric absorbance at 530 nm was measured using a Spectronic 710 spectrophotometer. Readings were converted at mg malonaldehyde/kg sample and reported as TBA values (mg TBA/kg meat).

Microbiological analysis:

Twenty five grams of samples were aseptically homogenized in 225 ml of sterile buffered peptone water for 1 minute. Serial dilutions were made in the same sterile peptone water, and then used for microbiological analysis during the time of refrigerated storage.

Aerobic plate count:

Aerobic plate counts (APC) were determined by incubating 0.1 ml of the sample homogenate at selected dilutions, for 48 hrs at 35°C.

Lactic acid bacteria:

For lactic acid bacteria (LAB), diluted samples were plated on de Man, Rogosa and Sharpe (MRS) agar, and incubated at 30°C for 2-3 days in an anaerobic jar.

Psychrotrophic bacterial count:

Psychrotrophic counts (PTC) were determined in a similar method to that of APC except that plates were incubated at 7°C for 10 days according to the methods of *Cousin et al.*, (1992).

Statistical analysis:

Data were analyzed by analysis of variance (ANOVA) to determine if treatments were significantly different (*Gill, 1981*).

Results and discussion

Figure 1. clearly illustrates the effect of antimicrobial agents in combination with packaging treatment, and time of storage on the pH changes in refrigerated buffalo ground meat. The data demonstrate that the initial pH value of the untreated sample was higher than the treated ones. The data also showed reduction in the pH values for the control and NaCl treated samples till the day twelve of storage, and then started to increase again. Whereas, the addition of NaL

almost maintained the pH value for the ground buffalo meat constant during the time of storage.

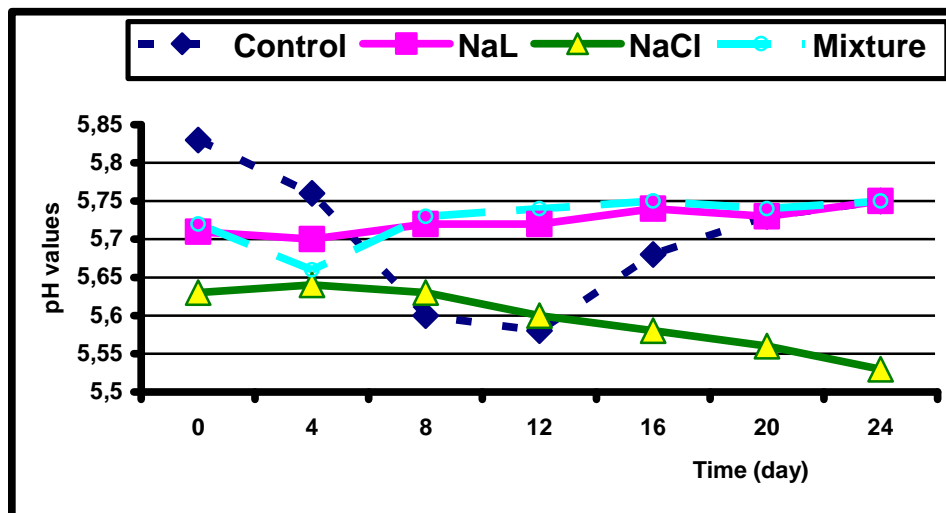


Figure 1. Effect of antimicrobial agents on the pH values of buffalo meat stored under refrigerated condition

TBA values are used as an index of lipid oxidation in meat products during storage.

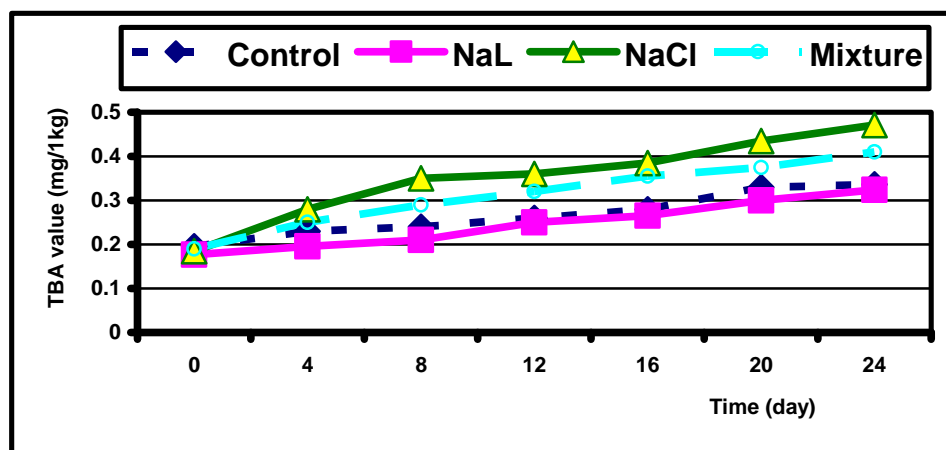


Figure 2. Effect of antimicrobial agents on the TBA values of buffalo meat stored under refrigerated condition.

TBA values for treatments at various storage times were plotted as shown in Fig. 2. The data showed that there was significant ($P < 0.01$) increase in the TBA value for all samples with time of storage. Sample treated by NaL showed the lowest value of TBA, while sample treated by NaCl showed the highest value of TBA during storage period. This means that NaL had an antioxidant effect which reflects the minimum increase in the TBA values during storage period, while NaCl had a pro-oxidative effect and enhanced the lipid oxidation of the samples during storage time

The use of combination of NaCl and NaL reduced the oxidative changes caused by NaCl. This result is in accordance with *Tan and Shelef (2002)*. Figure 3. illustrates the antimicrobial-time interaction on the total aerobic plate count of refrigerated buffalo ground meat. The data show that the control sample reached the maximal recommended limit at the eighth day of storage, whereas samples treated by NaCl and NaL reached the same limit after eleven and twenty days of storage respectively.

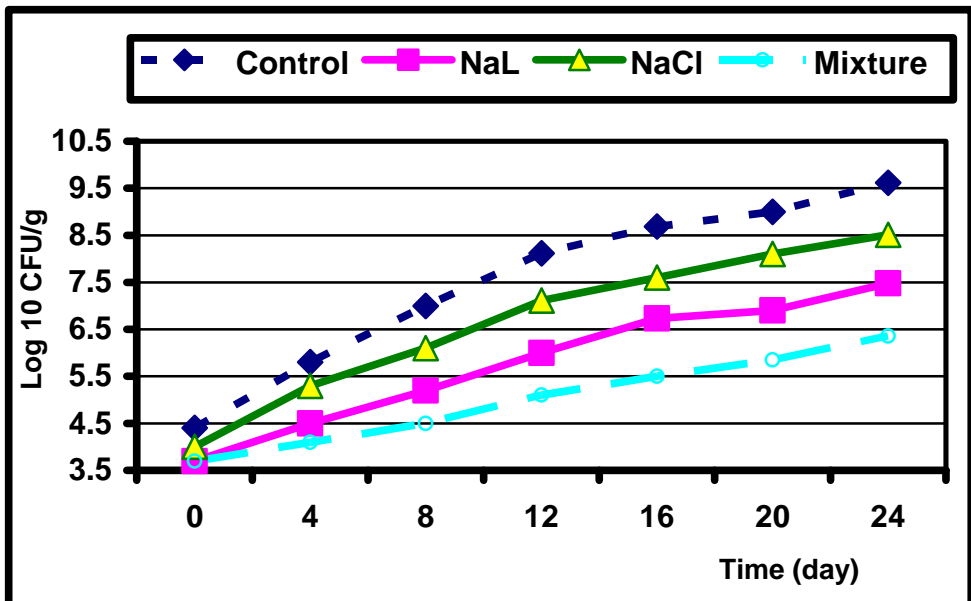


Figure 3. Effect of antimicrobial agents on the total plate count of buffalo meat stored under refrigerated condition

The results indicated that NaL treatment significantly delayed the microbial growth and extended the shelf life of the product up to twenty days and this comes

in agreement with (Brewer et al., 1995; Eckert et al., 1997; Maca et al., 1997; Maca et al., 1999).

Samples treated by mixture of NaL and NaCl did not reached the maximal recommended limit during the whole storage period, and had a lower microbial count than the maximal recommended limit. This result might have been due to the synergistic effect of the two salts.

The effect of antimicrobial treatment on the lactic acid bacteria (LAB) was illustrated in Fig. 4. The data showed that the addition of NaL alone did no produce significant reduction in lactic acid bacterial count ($P<0.05$) although it was almost one log lower than control. It has been shown that treatment by mixture of NaL and NaCl restricted the growth of LAB count during the storage period. This indicated that addition of NaCl was more effective ($P<0.05$) against lactic acid bacteria than NaL. This result comes in agreement with what was reported by (Sameshina et al., 1997; Zivkovic et al., 2002).

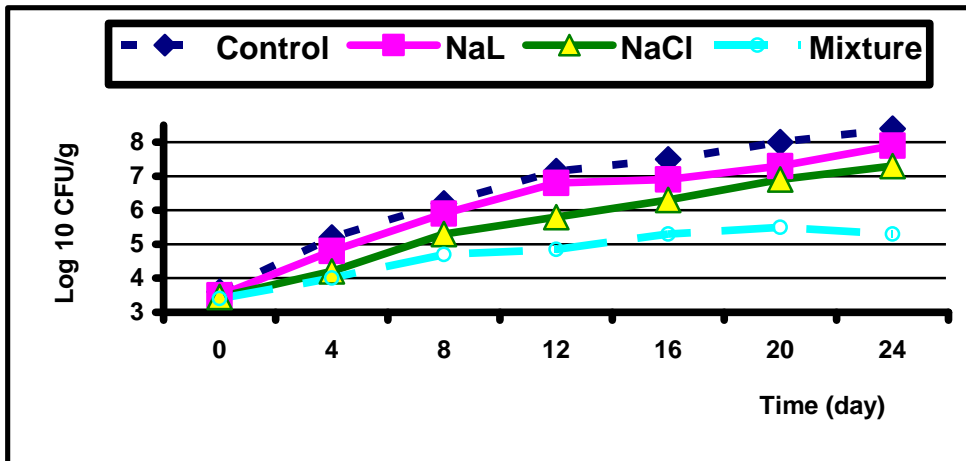


Figure 4. Effect of antimicrobial agents on the lactic acid bacterial count of buffalo meat stored under refrigerated condition.

Figure 5. illustrates the effect of antimicrobial treatments on the psychrotrophic bacterial count. The data showed that the psychrotrophic bacterial count increased with the progressing of the storage time. The use of NaCl alone or in combination with NaL restricted the growth of th microorganism and was more effective than NaL alone. The bottom line is significant differences ($P<0.05$) were detected in psychrotrophic count between samples treated with NaCl either alone or in combination with NaL and those of control.

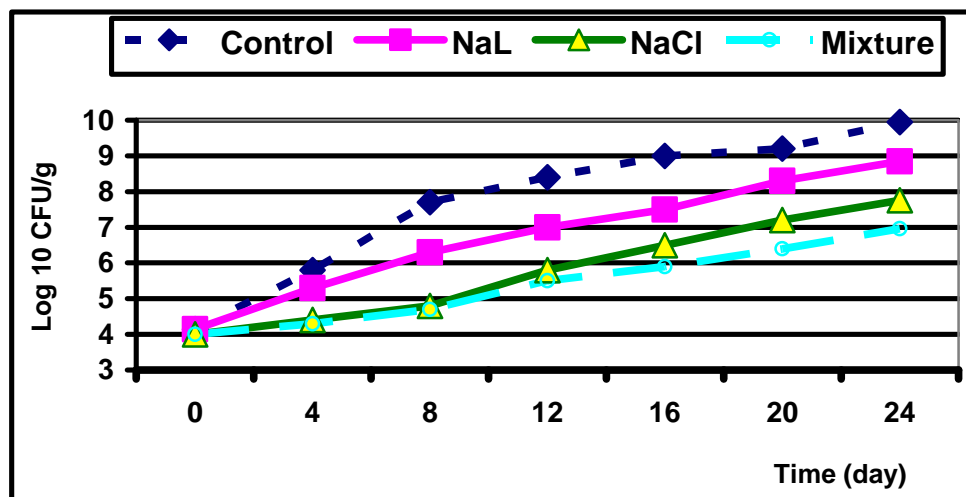


Figure 5. Effect of antimicrobial agents on the psychrotrophic bacterial count of buffalo meat stored under refrigerated condition.

Efekat antimikrobiološkog agensa na neke hemijske i mikrobiološke karakteristike vakuum pakovanog mlevenog bivoljeg mesa skladištenog u hladjenim uslovima

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Rezime

Hemijske karakteristike i mikrobiološko ispitivanje vacuum pakovanog mlevenog bivoljeg mesa tokom čuvanja u trajanju od 24 sata u hladnim uslovima su određivane u cilju ocene dva različita antimikrobiološka agensa natrijum laktata i natrijum hlorida, kao i njihove kombinacije.

Rezultati ukazuju da je korišćenje natrijum laktata sa ili bez natrijum hlorida, odložilo proliferaciju aerobnih mikroorganizama, psihrotrofnih mikroorganizama, mlečne kiseline i bakterija, i produžilo rok trajanja na više od 24 i 21 dana, respektivno, u poređenju sa 8 dana za kontrolne uzorke.

Vrednosti tiobarbiturne kiseline TBK u uzorcima tretiranim natrijum hloridom nisu bile pod uticajem ovog faktora, dok su na kraju perioda skladištenja vrednosti tiobarbiturne kiseline u uzorcima tretiranim natrijum laktatom pokazale

značajno smanjenje oksidativnih promena. Prema tome, korišćenjem natrijum laktata sa ili bez natrijum hlorida se može produžiti rok trajanja mlevenog bivoljeg mesa tokom skladištenja u hladnim uslovima smanjivanjem hemijskih i mikrobioloških promena.

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