The changes in pork quality in relation to packaging conditions during chilled storage in households

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Abstract

The effects of several different common packaging methods for storing fresh meat in households on the various quality characteristics of pork loin were examined during storage at 5□. These methods were: wrapping with polyethylene pouch (WP), keeping in an air-tight plastic container (CP), and using a household vacuum packaging machine (VP). The increase in the total aerobic bacteria (TPC) during storage was fastest in the WP samples, followed by the CP and VP samples. The increase in thiobarbituric acid (TBA) and volatile basic nitrogen (VBN) values over the storage period occurred most significantly in the WP samples compared to the CP and VP samples. The off-odour, tested 30 min after opening the pack, was first notable at day 15 in the CP and VP samples and at day 11 in WP samples. The colour deteriorated earlier in the WP samples than in the CP and VP samples. According to the sensory tests, WP samples were evaluated to be the worst over the storage period.

Introduction

Shelf life of fresh meat can be affected by some problems encountered during chilled storage, i.e. microbial growth, lipid oxidation, discoloration and increase of weep loss etc. (Hotchkiss, 1994; Lee & Yoon, 2001). In households, the left-over fresh meat from the meal should be stored in a refrigerator properly until it will be consumed again. However, in most of the current refrigerators for storing fresh meat, humidity control is poorly conducted. Therefore, by introducing an appropriate packaging, shelf life of meat can be extended by excluding the sources of additional microbial contamination and reducing evaporation during chilled storage. Most commonly, left-over fresh meat is stored in the households either by wrapping with gas permeable film or by putting in a household plastic pouch. Alternatively, meat can be kept in plastic air-tight containers, the use of which for preserving different kinds of foodstuffs and meals is, nowadays, widespread in households. More recently, the use of household vacuum packaging machines is becoming popular. Therefore, a study was carried out to compare the effects of these kinds of different common packaging methods for storing fresh meat in households on the various quality characteristics of pork loin stored at 5□.

Materials and methods

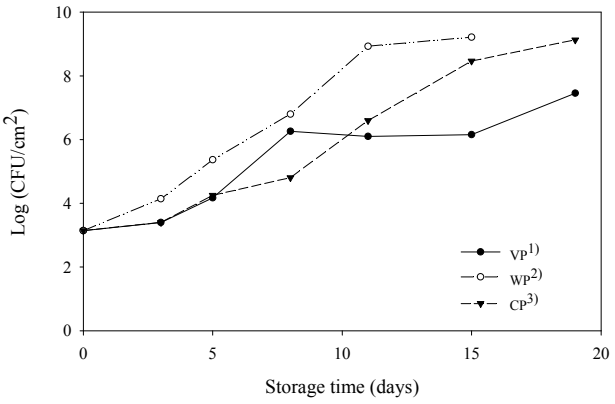
Both sides of loin were removed by sanitary sampling methods from five pigs, 24 h postmortem, in A grade, according to the Korean carcass classification system. pH24 values of sample meats ranged between 5.6 and 5.8. The samples were trimmed from exterior fat and cut into lengths of 6 cm, thus obtaining 38 pieces in total. The packaging methods incorporated in this experiment were as follows; (1) wrapping with household high density polyethylene pouch (WP), thickness 25 ㎛ (Lotte Aluminum Co., Korea), keeping in an air-tight container made of polypropylene (CP) (Lock & Lock Co., Korea), and using a household vacuum packaging machine (VP) (VP-3000, Foodguard, Korea). The samples were then stored in a low temperature incubator (BI-1000M, Jeio Tech., Korea) at 5±0.5□ and were allocated to each of seven intervals (0, 3, 5, 8, 11, 15, and 19 days).

The TPC was determined by incubation on a Standard-I agar (Merck, Germany) at 30□ for 2 days. The pH was measured using a combined glass electrode (720A, Orion, USA). Changes in the TBA were used to assess lipid oxidation (Witte et al., 1970). The VBN test using the microdiffusion technique of Conway (1958) was used to determine proteolytic degradation.

A trained, 10-member sensory panel evaluated meat samples by using a 5-point hedonic scale with 0.5 intervals for discoloration and off-odour (5=none; 1=total) and outer appearance (5=extremely desirable; 1=extremely undesirable). This experiment was replicated twice and the mean values were obtained from six measurements on three separate samples at each day. All data were analyzed using Statistical Analysis System (SAS/STAT, 1988). Duncan's Multiple Range Test was used to compare means and significance which was established at $P<0.05$.

Results and discussion

Figure 1 shows the changes in the TPC of the pork samples over the 19 days of storage at 5±0.5□. The initial count of the TPC was 3.17 log10CFU/㎠, and it's increase during storage was fastest in the WP sample, followed by the CP and the VP samples. The TPCs in CP and VP samples were maintained similarly at levels with 4.19 and 4.25 log10CFU/㎠ until the 5th day, respectively. However, from that day, the TPC in the WP sample began to show a significantly higher level than in the other treatments. After 15 days, the TPCs in the WP, CP and VP samples increased to 9.32, 8.25 and 6.16 log10CFU/㎠, respectively.



1) Household vacuum packaging machine
2) Wrapping with high density polyethylene pouch
3) Air-tight container

Figure 1 Changes in the TPC of pork loins during storage at 5±0.5℃.

Table 1 shows the comparative values of pH, TBA and VBN of pork loins packed in the WP, CP and VP. The pH values were at the lowest after 3, 5-8 and 8 days in the VP, CP and WP samples, respectively, and then increased with time up till the 19th day. Those of the WP and CP samples increased up to 6.0 at the end of the storage time, probably by an aerobic putrefaction. The TBA values increased with the storage time in all packaged samples. From the 5th day, the TBA value of the WP samples increased rapidly compared to the CP and VP samples. This indicated the faster development of lipid oxidation in the meats wrapped with oxygen permeable polyethylene compared to other treatments. However, it might have been retarded by preventing the oxygen-inlet into the container as in the CP and into the gas-tight film as in the VP. The VBN value, which is being used in routine monitoring of meat in the Far East countries, was initially 3.73 mg% and increased linearly with storage time to 18.2 and 19.1 mg% in CP and VP after 15 days, respectively. However, the level in the WP sample exceeded the putrefaction criterion of 20 mg% prescribed in the Korean specification (KFDA, 1999) after 11 days.

Table 1. Change in the pH, TBA and VBN of pork loins packed in WP, CP and VP during storage at 5° C

		Storage time (days)						
		0	3	5	8	11	15	19
pH	VP[2)]	5.77^{a}	5.62^{c}	$^{A}5.63^{c}$	$^{A}5.66^{bc}$	$^{B}5.69^{b}$	$^{B}5.68^{b}$	$^{B}5.78^{a}$
	WP[3)]	5.77^{c}	5.65^{d}	$^{B}5.48^{e}$	$^{B}5.44^{e}$	$^{A}5.89^{b}$	$^{A}6.06^{a}$	-
	CP[4)]	5.77^{c}	5.70^{d}	$^{A}5.64^{c}$	$^{A}5.64^{e}$	$^{B}5.68^{de}$	$^{B}5.90^{b}$	$^{A}6.06^{a}$
TBA	VP	0.19^{d}	$^{B}0.20^{d}$	$^{B}0.23^{c}$	$^{B}0.24^{c}$	$^{B}0.32^{b}$	$^{B}0.33^{b}$	0.37^{a}
	WP	0.19^{e}	$^{A}0.26^{d}$	$^{A}0.35^{c}$	$^{A}0.31^{cd}$	$^{A}0.41^{b}$	$^{A}0.62^{a}$	-
	CP	0.19^{d}	$^{B}0.20^{d}$	$^{B}0.23^{c}$	$^{B}0.25^{c}$	$^{B}0.32^{b}$	$^{B}0.36^{a}$	0.38^{a}
VBN	VP	3.73^{e}	$^{C}2.80^{e}$	$^{B}3.73^{e}$	$^{B}7.00^{d}$	$^{B}13.53^{c}$	$^{B}18.20^{b}$	24.07^{a}
	WP	3.73^{ef}	$^{A}7.93^{de}$	$^{A}12.13^{d}$	$^{A}18.67^{c}$	$^{A}24.73^{b}$	$^{A}40.13^{a}$	-
	CP	3.73^{e}	$^{B}4.20^{e}$	$^{B}5.13^{e}$	$^{B}8.40^{d}$	$^{B}14.00^{c}$	$^{B}19.13^{b}$	25.67^{a}

$^{A\sim C}$ Means with the same column are not significantly different (P>0.05)
$^{a\sim f}$ Means with the same row are not significantly different (P>0.05)
1) 30 min after opening the pack 2), 3), 4) Refer to Figure 1

Table 2 shows the result of sensory evaluation. The discolouration as evaluated below the level 3.0 of marketable criteria occurred after 11 days in the WP and 15 days in the CP and VP samples. The first off-odour was detected at day 15 in the CP and VP samples, while at day 11 in the WP sample. In the VP samples after 11 days of

storage, a slight sour odour was detected immediately after opening the pack; however, it disappeared after 30 min. The results evaluated for the outer appearance of samples were similar as with off-odour. These results indicated that the film wrapping of fresh meat induced the increase of the relative humidity resulting in the shortening of shelf life (Bem & Hechelmann, 1995).

Table 2. Changes in the sensory evaluation scores of pork loins packed in WP, CP and VP during storage at 5 °C

		Storage time (days)						
		0	3	5	8	11	15	19
Color	VP[1)]	5.00^{a}	$^{B}4.33^{b}$	4.28^{b}	$^{B}3.83^{c}$	$^{A}3.28^{d}$	$^{A}2.72^{e}$	$^{A}2.22^{f}$
	WP[2)]	5.00^{a}	$^{A}4.72^{b}$	4.28^{c}	$^{B}3.78^{d}$	$^{B}2.33^{e}$	$^{B}1.33^{f}$	-
	CP[3)]	5.00^{a}	$^{A}4.94^{a}$	4.56^{b}	$^{A}4.33^{b}$	$^{A}3.28^{c}$	$^{A}2.44^{d}$	$^{B}1.72^{e}$
Appearance	VP	5.00^{a}	$^{B}4.50^{b}$	$^{A}4.28^{b}$	$^{C}3.33^{c}$	$^{A}3.00^{cd}$	$^{A}2.67^{d}$	$^{A}2.22^{e}$
	WP	5.00^{a}	$^{B}4.44^{b}$	$^{B}3.94^{c}$	$^{B}3.67^{c}$	$^{B}2.39^{d}$	$^{B}1.33^{e}$	-
	CP	5.00^{a}	$^{A}4.89^{a}$	$^{A}4.39^{b}$	$^{A}4.06^{c}$	$^{A}3.22^{d}$	$^{A}2.56^{e}$	$^{B}1.72^{f}$
Off-flavor	VP	5.00^{a}	$^{A}4.83^{a}$	$^{AB}4.17^{b}$	$^{B}3.44^{c}$	$^{A}3.00^{d}$	$^{A}2.39^{e}$	1.72^{f}
	WP	5.00^{a}	$^{B}4.39^{b}$	$^{C}3.83^{c}$	$^{B}3.56^{d}$	$^{B}1.72^{e}$	$^{B}1.11^{f}$	-
	CP	5.00^{a}	$^{A}4.83^{a}$	$^{A}4.39^{b}$	$^{A}4.22^{b}$	$^{A}3.39^{c}$	$^{A}2.39^{d}$	1.61^{e}

$^{A\sim C}$ Means with the same column are not significantly different (P>0.05)
$^{a\sim f}$ Means with the same row are not significantly different (P>0.05)
$^{1), 2), 3)}$ Refer to Figure 1

Conclusions

According to the sensory tests, the WP samples were evaluated to be the worst, while the CP and VP samples showed comparable quality characteristics over the storage period. Although the CP can be effectively used for preserving fresh pork in households, the VP showed slightly more favourable results in some quality parameters than the CP method.

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