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Shelf Life Extension of Korean Fresh Pasta by Modified Atmosphere Packaging

– Research Note –

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Abstract

Fresh pasta was packaged in a modified atmosphere of 22% CO_2 /78% N_2 and compared with a control air package for its quality changes during storage at 8°C. The modified atmosphere packaging suppressed the microbial growth of total aerobic bacteria and yeasts/molds with a concomitant reduction in the rates of physical and chemical quality changes, and thus successfully extended the shelf life of fresh pasta from 20 days of air packs to 40 days based on microbial criterion of 10^6 cfu/g. The shelf life extension was greater when the initial microbial quality of the product was better

Key words: fresh pasta, microbial quality, modified atmosphere, gas packaging, carbon dioxide

INTRODUCTION

Modified atmosphere packaging (MAP) is known to be effective in preserving the quality of pasta products (1). The gas composition of modified atmosphere (MA) usually adopted for fresh pasta packaging covers 20~100% CO_2/0~80% N_2 (2,3). The MAP is generally reported to extend the shelf life of fresh pasta by two or three fold. Mok (4) reported that fresh extruded noodle could be stored with better quality when packed with oxygen absorbent.

Recently, Korean-style fresh pasta (*kalguksu*) began to appear in the supermarket, and its production has gradually increased to constitute a significant portion of the total pasta production in Korea (5). It is characterized by high moisture content and plain flavor. Because of rapid quality deterioration at ambient temperatures, the pasta products are stored, distributed and marketed under chilled conditions. Park et al. (6) reported that the pasta shelf life doubles with a temperature reduction of 10°C. Additives such as ethanol and chitosan were also shown to extend the shelf life based on the microbial criterion (7).

The packages of Korean fresh pasta are mostly pouches or trays at normal atmosphere, and therefore have a limited shelf life of less than 2 weeks. As mentioned above, there is a good potential to extend shelf life for these products by applying MAP. This study therefore aims to examine the effect of MAP on the shelf life extension of Korean style fresh pasta.

MATERIALS AND METHODS

Fresh pasta

Experiments were conducted twice starting on January 18 and February 8, 2000. Each time the fresh pasta products manufactured at Pulmuone Co., Ltd., Chuncheon, Korea, were transported in refrigerated conditions on the day of production, and then packaged on the following day. The raw ingredients included wheat flour, water, salt and a small amount of ethyl alcohol. The pasta had been produced without any pasteurization by a process consisting of kneading, lamination and cutting. The general composition was moisture at 32.9%, carbohydrates at 59.0%, protein at 5.0%, fat at 0.7% and ash at 2.4%, which was provided by the manufacturer. Water activity measured by a Novasina Hygrometer (model Humidat-IC, Novasia AG, Switzerland) was around 0.91.

Packaging and storage

In the first set of experiments, the pasta was packed in units of 150 g in a control package at normal atmosphere and a MA package of 22% CO_2/78% N_2. The control package was a polystyrene (PS) tray of 12.5×17.0 cm stretch-wrapped with a polyvinyl chloride film (PVC, 14 μm thickness). The MA package was made of a high barrier plastic film pouch of 12.5×17.0 cm, which was gas-flush packed by a chamber type machine (model M-6TM, Leepack, Bucheon, Korea). The packaging film was coextruded nylon/ethylene vinyl alcohol/linear low density polyethylene (Nylon/EVOH/LLDPE) of 89 μm thickness (T7330B, Cryovac Division, Duncan, SC, USA). The second experimental trial was performed in the same way as in the first experiment except that the package size was 160g. All the packages were stored at 8°C with monitoring of the package atmosphere and qualities of the foods.

Analysis

At each sampling time, at least 3 packages were taken out for measurement of package atmosphere and pasta qual-

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ity. The weight loss was determined by weighing the packages to the nearest 0.1 g and expressed as a percentage of the initial package weight. Gas samples of 1 mL were taken with an gas-tight syringe from the packages, and the gas concentrations of O_2, CO_2 and N_2 were determined using a gas chromatograph (Model 163, Hitachi Ltd., Tokyo, Japan) equipped with a thermal conductivity detector and an Alltech CTR I column (Alltech Associates Inc., Deerfield, IL USA). The column temperature was maintained at 40°C, injection temperature at 70°C, and detector at 90°C. Helium, which was flowing at 30 mL/min, was used as the carrier gas.

For the determination of microbial counts, 8 g of the sample was washed with 72 mL of sterile 0.1% peptone water in a Lab-Blender (TMC International, Seoul, Korea) for 3 min. The washed solution was serially diluted with 0.1% peptone water, and 0.1 mL of the diluted solution was spread plated on nutrient agar media. Total aerobic microbial count was performed on a Plate Count Agar (Difco Laboratories, Detroit, USA) plates in 2 days at 35°C. Yeast and mold count was performed on an acidified (pH 3.5) Potato Dextrose Agar (Difco Laboratories, Detroit, MI, USA) in 5 days at 25°C.

The pH was measured with a pH meter (model 520A, Orion Research Inc., Boston, MA, USA) equipped with an electrode for semi-solid food. Pasta texture was measured with a Rheometer (Model Compac-100, Sun Scientific Co., Tokyo, Japan) whose knife adapter of 0.26 mm thickness cut a strand of pasta perpendicularly. The yield force was recorded as hardness of the pasta. Surface color was measured with a Color Difference Meter (model JC 801, Color Techno System Corporation, Tokyo, Japan).

RESULTS AND DISCUSSION

In both sets of experiments, the MA packages initially flushed with gas of 22% CO_2 and 78% N_2 maintained CO_2 concentration of 17~19% for the whole storage period, while the control packages showed a gas composition similar to normal air with negligible accumulation of CO_2 gas inside the package (Fig. 1). The film of Nylon / EVOH / LLDPE used for MA packaging seemed to have a barrier property sufficient to protect the product from oxygen through the whole storage period of over than 60 days. Initial decrease in CO_2 concentration for MA packages would have resulted from dissolution of CO_2 gas in the fresh pasta. Stretch wrapping on the control packages did not provide hermetic sealing and caused some degree of air leak, which was shown by their gas compositions similar to normal air (O_2 21% and N_2 79%).

The package atmosphere influenced microbial growth on the fresh pasta with significantly lower microbial counts of total aerobic bacteria and yeasts/molds for the MA packages of approximately 20% CO_2 concentration (Fig. 2). Because microbiological quality is a major concern in non-

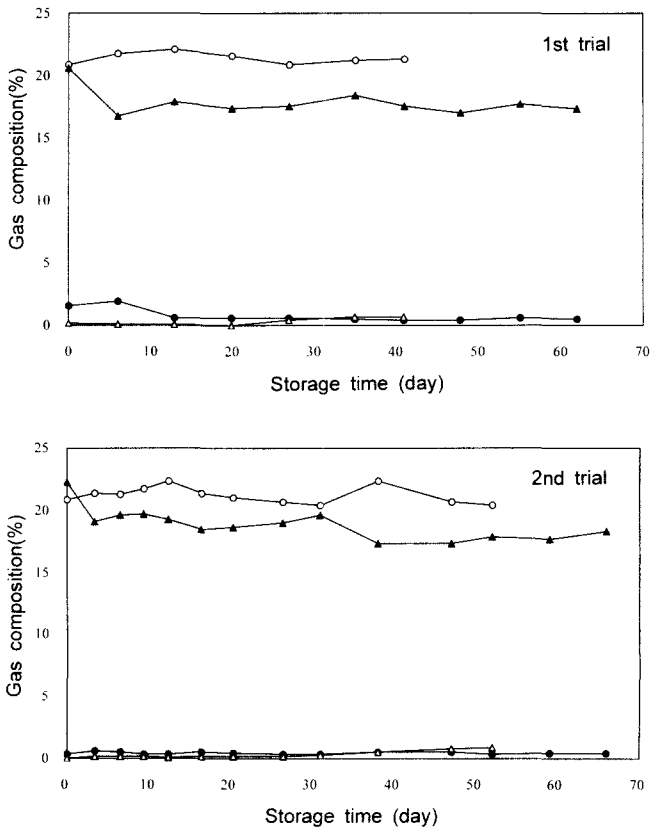

Fig. 1. Comparison in the gas compositions between control and MA packages of fresh pasta at 8°C. ○, O_2 in control package; △, CO_2 in control package; ●, O_2 in MA package; ▲, CO_2 in MA package.

pasteurized pasta products (3,6), inhibition of microbial growth by MAP would be one of the most desirable aspects for its shelf life extension. When using the microbial quality limit as 10^6 cfu/g of total aerobic bacteria (6), the control packages had a shelf life of 14 days for the first experiment and 26 days for the second experiment, while the MA packages did not reach this level even after 60 days. The effect of the modified atmosphere on yeasts/molds was less pronounced compared to that on the total aerobic count. Considering this point, shelf life determination in MA packages may be based on the count of yeasts/molds. Day (2) suggested a shelf life of 1~2 weeks for air packs of fresh pasta and 3~4 weeks for MA packs at 0~5°C. MAP of non-pasteurized fresh pasta with pH>5 and water activity<0.95 was given about a 30-day shelf life (3). Brody (1) reported a shelf life of just a few days for normal air packages and 40 days for MA packages for fresh pasta with a moisture content of 30%.

The pH started to decrease noticeably for control packages after 20 days in the first experiment and after 26 days in the second experiment probably due to microbial growth (Fig. 3). A pH decrease has also been observed by Lee et al. (7) for fresh pasta stored at 4°C. On the other hand, MA packages showed a relatively unchanged pH through the storage. Only a slight decrease in pH occurred after 41 and

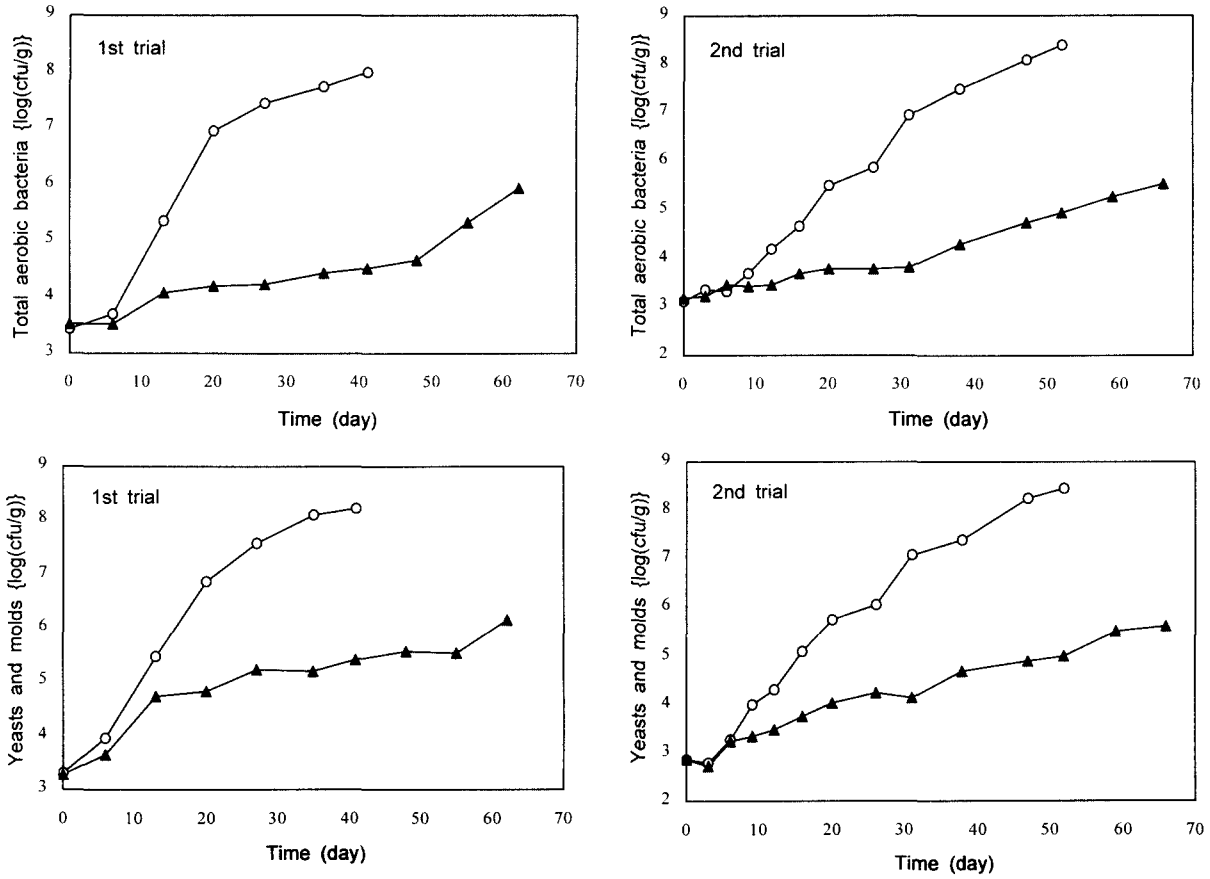

Fig. 2. Microbial counts of fresh pasta in control and MA packages at 8°C. ○: control package, ▲: MA package.

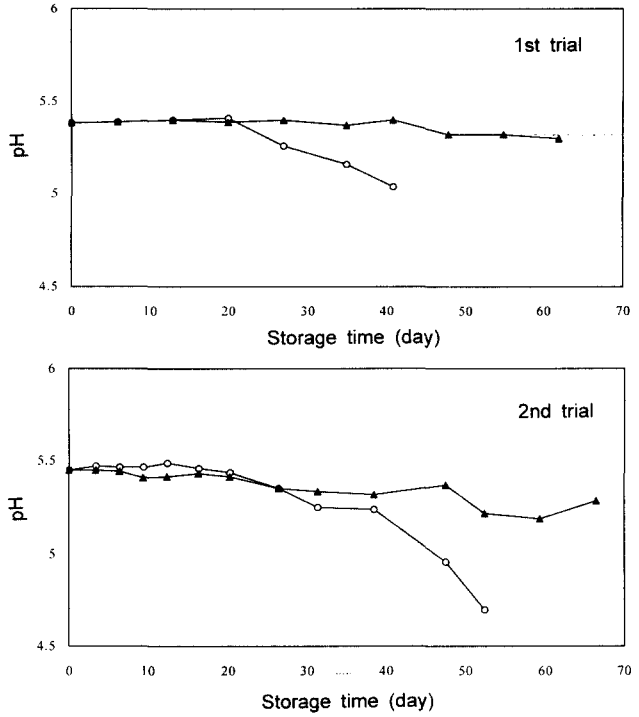

Fig. 3. pH change of packaged fresh pasta at 8°C. ○: control package, ▲: MA package.

47 days for the first and second experiments, respectively. If this pH change is used as a criterion of quality limit, MAP seemed to extend the shelf life of the pasta from about 20 days in air packages to about 40 days, which is more conservative than when based on microbial criterion.

The non-hermetic property of stretch wrapping and high water permeability of PVC wrap of the control packages resulted in high weight loss and thus harder texture with storage (Fig. 4). MA packages did not show any discernible changes in weight loss and pasta texture. Surface color change of fresh pasta products measured by Hunter color system was very small, and thus it was hard to differentiate the effect of packaging treatment on that (data are not shown here).

Generally, the effect of packaging treatment was consistent for both trials of packaging and storage. MAP was shown to extend the shelf life of the pasta products considerably. The initial microbial quality of pasta for the second experiment was better than that for the first experiment. Therefore, all the quality changes were slower and lagged in the second experiment, which thus provided longer shelf life. This emphasizes the importance of quality control in raw materials and manufacturing practices to ensure desired shelf life. Good sanitary practices are also recommended for safety considerations in wet pasta products (8).

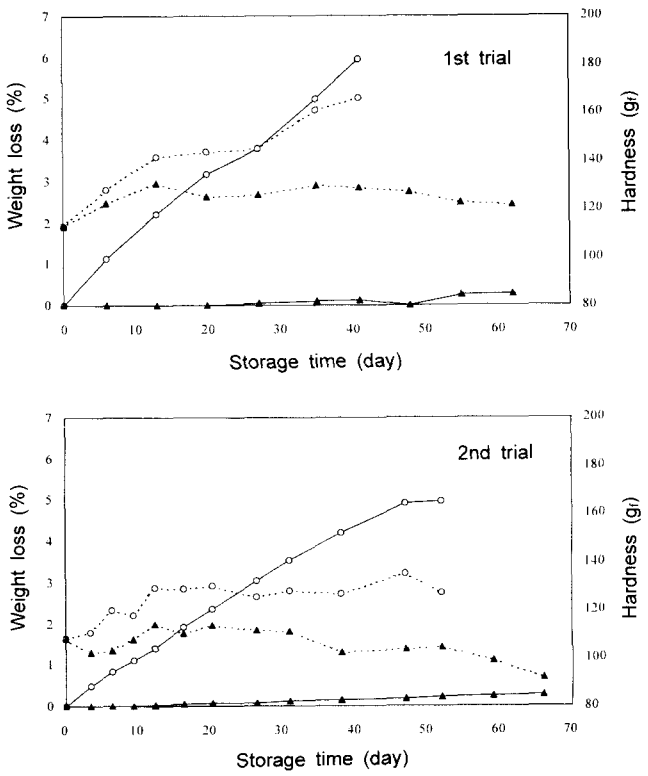

Fig. 4. Weight loss and texture change of packaged fresh pasta at 8°C. ○: control package, ▲: MA package. Solid lines are weight loss and dotted lines are texture change.

CONCLUSIONS

MAP of CO_2 22%/N_2 78% could successfully extend the shelf life of fresh pasta products from about 20 days of air packs to about 40 days based on the criterion of microbial deterioration. The extended shelf life may be longer if the initial product quality is better.

ACKNOWLEDGEMENTS

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