Packaging of fresh beef in different gas mixtures

L.R. Turubatovic[1*], M.P. Milijasevic[1], J.B. Jovanovic[1] & B.M. Velebit[1]
[1]Institute of Meat Hygiene and Technology, Kacanskog 13, 11000 Belgrade, Serbia,
*E-mail: lazar@inmesbgd.com.

Introduction

During the last two decades modified atmosphere packaging (MAP) has become a dominant retail meat packaging technology. Main reasons that stimulate MAP development are continuous consumption of fresh meat, an increase of urban population and exhausting of natural food resources. MAP can be defined as a method of air removal from a packaging and its replacement by specific gas or gas mixture. Purpose of this technology is to prolong shelf life of foodstuffs by preventing or inhibiting biochemical reactions (fat oxidation, metmyoglobin formation), growth of spoilage bacteria and degree of product respiration. There are several gases being used independently or combined in gas mixtures. Carbon dioxide exhibits antimicrobial activity mostly toward gram negative bacteria and psyhrotrophic pathogens such as *Y. enterocolitica* and *A.hydrophila*. There is no significant growth inhibition of *L .monocytogenes*. CO_2 also doesn't affect growth of *Cl. botulinum.* Oxygen has been used to preserve colour of meat slices and to suppress growth of anaerobic bacteria. Nitrogen is inert gas which can replace oxygen and increase shelf life. It also prevents onset of rancidity and inhibits growth of aerobic bacteria. Moreover, nitrogen can prevent collapse of packaging due to low solvability. Carbon monoxide is very efficient in preservation of red colour of fresh meat since it has 20 times higher affinity to bind to myoglobin compared to oxygen. Sulphur dioxide is known to inhibit bacterial growth when pH value is below 4. Aim of this experiment was to investigate effects of different gas mixtures on colour and microbiological status of MAP packaged beef.

Materials and methods

Experiment has been performed in mid-sized meat processing plant. Beef primal cuts were used as a sampling material. Average meat temperature during primal cutting was 3.1°C, while pH was 5.75. Twenty-four hours later primal cuts were sliced, while the average temperature was 4.2°C and pH value of meat was 5.54. Temperature and pH values were measured in triple, using Testo 205 pH meter (Testo AG, Germany). Each slice of meat, 1-2 cm thick, was placed in Cryovac LidSys polystyrene containers 50 mm high (Sealed Air, USA) supplied with SupaLoc absorbent pads (Sealed Air, USA). Slices were immediately packaged in modified protective atmosphere and were kept for 28 days at the temperature of 4°C. A total of 5 different gas mixtures (Messer AG, Germany) were used (Table 1.).

On days 2, 6, 13, 17 and 28, microbiological status and pH value have been evaluated. Colour of meat was evaluated subjectively, at the beginning and the end of experiment, without instrumental measuring. Microbiological examination has been performed in concordance with current ISO methods (data not shown). Following microorganisms have been investigated using appropriate media (Merck AG, Germany): total viable count (TVC), *E.coli*, *Salmonella* spp., *L.monocytogenes*, *Proteus* spp. and sulphite-reducing *Clostridia*.

Table 1. Composition of gas mixtures

	Mix 1	**Mix 2**	**Mix 3**	**Mix 4**	**Mix 5**
CO_2	30%	100%	50%	30%	20%
O_2	-	-	-	70%	20%
N_2	70%	-	50%	-	60%

Results and discussion

Results of microbiological investigation are presented in Figure 1. At slices packaged under gas mixture consisting of 30% CO_2 and 70% N_2 and particularly at 100% CO_2 TVC remained low, relative to other gas mixtures, during almost entire period of investigation. Beef slices packaged at 20% and 70% O_2

exhibited continuous increment of TVC with a sudden ramp between day 13 and 17. Presence of any pathogenic bacteria in any of MAP packaged beef slices haven't been recorded in this research.

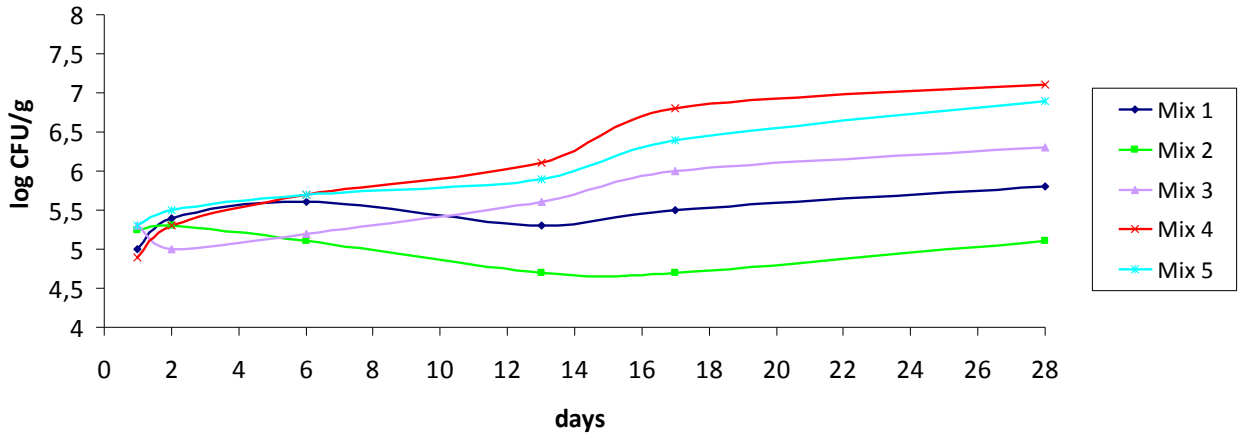

Figure 1. TVC trend during experiment.

Results of pH value investigation are presented in Figure 2. There was significant increase of pH value at slices packaged under gas mixture consisting of 70% O_2. Other mixtures exhibited slow but continuous increment of pH value. Ramp increment had also been noticed about day 15.

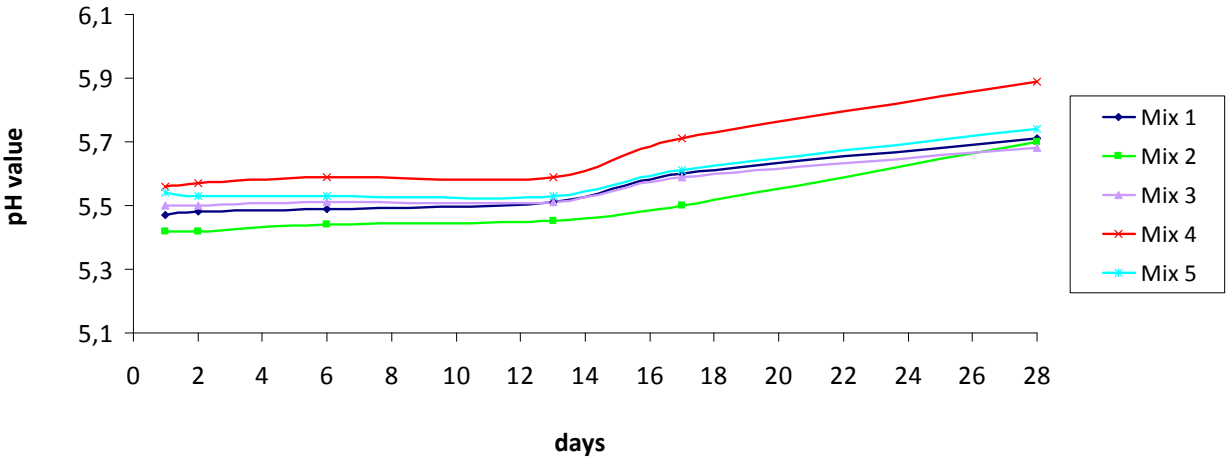

Figure 2. pH value trend during experiment.

Colour of slices at the beginning and at the end dramatically changed in a sense that slices packaged in high CO_2 % atmosphere received dark green colour. Slices packaged in 30% CO_2 and 70% O_2 retained the most appropriate red colour.

Conclusions

According to this study samples packaged in atmosphere containing 70% O_2 and 30% CO_2 were featured with best sensory and microbiological results.

Acknowledgements

This paper was financially supported by Serbian Ministry of Science and Environmental Protection within the research project "Beef Confectioning and Sterilized Beef Can" BTN-351001B.

References

Brody, A.L., 2003. „Nano, Nano“ Food Packaging Technology. J. of Food Technology, (57), 12, 52-54;

Djenane, D., Sánchez-Escalante, A., Beltrá, J.A., Roncalés, P., 2001. Extension of the Retail Display Life of Fresh Beef Packaged in Modified Atmosphere by Varying Lighting Conditions. J. of Food Science, (66), 1, 181-185;

Hess, E., Ruosch, W., Breer, C., 1980. Extending the shelf-life of prepacked fresh meat. Fleischwirtschaft, (60), 8, 1513-1516;

Klettner P.-G., 2004. Schutzgasverpackung bei Frischfleisch (Rückenmuskulatur von Schwein und Rind) unter besonderer Berücksichtigung von Kohlenmonoxid, Mitteilungsblatt der Fleischforschung, Kulmbach 43. Nr. 166, 331-342;

Krämer, Baumgart, 1992. Brühwurstaufschnitthemmung von Listeria monocytogenes durch eine modifizierte Atmosphäre. Fleischwirtschaft, 72, 666-668;

Sinell, H.-J., 1988. Mikrobiologie des Fleisches. In Prändl-Fischer-Schnidhofer-Sinell, 1988, Fleisch, Ulmer, 1988, Stuttgart

Xiong, Li, 1999. Modified Atmosphere Packaging. Dept. of Food Science, Penn State University.