

THE EFFECT OF MODIFIED ATMOSPHERE PACKAGING AND VITAMIN E DIETARY SUPPLEMENTED ON THE MICROBIOLOGY AND COLOUR STABILITY OF BEEF MINCE FROM VACUUM STORED WHOLESALE CUTS

EM Buys & J Krüger

Animal Nutrition and Animal Products Institute, Agricultural Research Council, Private Bag X2, Irene, South Africa, 0062

Background

Modified atmosphere packaging (MAP) has a two-fold advantage over conventional PVC overwrap. MAP inhibits microbiological growth and slows down the formation of metmyoglobin (Gill, 1996). During prolonged storage of meat a reduction in Saturation values and oxymyoglobin levels is found as a result of a decrease in the meat's enzyme activity which occurs during ageing or extended storage since meat colour is affected by the residual enzymatic activity (O' Keefe & Hood, 1982). This enzymatic activity, directly or indirectly, controls myoglobin oxygenation, oxidation and reduction (O' Keefe & Hood, 1982). However, it has been widely confirmed that dietary vitamin E supplementation during cattle feeding improves Saturation and reduces metmyoglobin formation during retail display (Arnold *et al.*, 1993, Zerby *et al.*, 1999).

Objective

To ascertain the microbiological and colour shelf life of beef mince, from bulls which were supplemented with dietary vitamin E, and packaged in a modified atmosphere (20 % CO₂: 80 % O₂) after vacuum storage of 6 weeks at 0 °C.

Methods

Four bulls were each fed a diet supplemented with 1000 mg (1000 IU) vitamin E per day (Hoffman-La Roche Incorporated, Isando, South Africa) and 4 fed the same diet not supplemented with vitamin E. The alpha-tocopherol-acetate was pre-mixed into the feed. After completion of the 90 days feeding period the cattle were slaughtered according to standard procedures.

The *M. adductor femoris*, *M. gracillis*, *M. semimembranosus* (topside) of each carcass (n=8, control and vitamin E) were removed from one hindquarter. The 8 cuts were vacuum packed in BB4L Cryovac barrier bags (OTR - 20 ml/m²/24h/atm at 23 °C & 75 % RH) (Darex Africa, Isando, South Africa) and aged at 0 - 2 °C for 6 weeks. All the muscles of each topside were minced and 250 g samples of mince from each topside were placed in 3 polystyrene trays respectively (Atlantic forming 69D/200, Darex Africa, Isando, South Africa). The trays were flushed with 80 % O₂: 20 % CO₂ using an Ilapak Delta 2000 packaging machine (Cryovac BDF foil, OTR - 20 ml/m²/24h/atm at 23 °C & 75 % RH) (Darex Africa). Three mince samples from each topside was also placed on styrofoam trays and over-wrapped with polyvinyl chloride (PVC) (oxygen transmission rate (OTR) - ca 5 000 ml/m²/24h/atm at 22 °C & 75 % relative humidity (RH)). All the mince samples were displayed at 4 °C for a period of 8 days in a Costan retail display cabinet (Hermagor, Austria).

After 0 - 8 d of retail display the packaged minced samples were assessed using microbiological and colour parameters. Aerobic plate, lactic acid bacteria, pseudomonad and *Enterobacteriaceae* counts were obtained. The colour of the unopened packaged mince samples were assessed with a Minolta chromometer (Tokyo, Japan). The percentage of metmyoglobin (MMb) was determined following the procedures of Krzywicki (1979) (Pye-Unicam 8700 Phillips spectrophotometer with a PU8700 diffuse reflectance accessory, Unicam Limited, United Kingdom).

Results and discussion

The aerobic plate count and lactic acid bacteria levels of all the mince meat samples, MAP and PVC, control and vitamin E, was all ready at levels of >log 6 cfu/g at day 0 of retail display due to the 6 weeks vacuum storage period. All the microbiological counts monitored was significantly influenced by the packaging method (MAP vs. PVC, $p \leq 0,05$) and retail display period (0,3, 8d, $p \leq 0,05$) (Fig. 1). However, the dietary vitamin E supplementation did not affect the microbiological counts significantly ($p \geq 0,05$).

Although the aerobic plate count of both packaging systems, MAP and PVC, increased at a similar rate during retail display, there was a significant ($p \leq 0,05$) packaging retail display interaction regarding the other microbiological counts monitored. The pseudomonads and *Enterobacteriaceae* levels of the MAP mince meat did not increase significantly during the first 3 days of retail display and the levels recorded on day 8 was at least 1 log cfu/g less than that of the PVC overwrapped mince meat. The lactic acid bacteria levels of the MAP mince meat did increase during retail display, but lower levels were also recorded at day 8 of retail display than for the PVC overwrapped samples (Fig. 1).

The MMb formation and Saturation (S) levels were significantly influenced by the packaging method (MAP vs. PVC, $p \leq 0,05$) and retail display period (0,3, 8d, $p \leq 0,05$) (Fig. 2). However, the dietary vitamin E supplementation did not affect the MMb formation and S significantly ($p \geq 0,05$). The MAP mince meat discoloured less during the first 3 days of retail display than the PVC overwrapped mince meat, but at day 8 the MMb levels of both treatments were above 80 %. There was a significant ($p \leq 0,05$) packaging retail display interaction regarding S. This indicated that the MAP had higher S values during retail display than the PVC overwrapped samples, the difference in S values always remained at ≥ 2 units, which represents a significant difference in colour (MacDougall, 1977).

Conclusion

A modified atmosphere of 80 % O₂: 20 % CO₂ inhibited the growth of pseudomonads and *Enterobacteriaceae* and increased the colour shelf life of mince meat during retail display at 4 °C, after 6 weeks vacuum storage at 0 °C. Dietary vitamin E supplementation

with 1000 IU /animal/day for 90 days had no significant effect on the colour stability of the mince meat in a modified atmosphere of 80 % O₂: 20 % CO₂ after 6 weeks vacuum storage at 0 °C.

References

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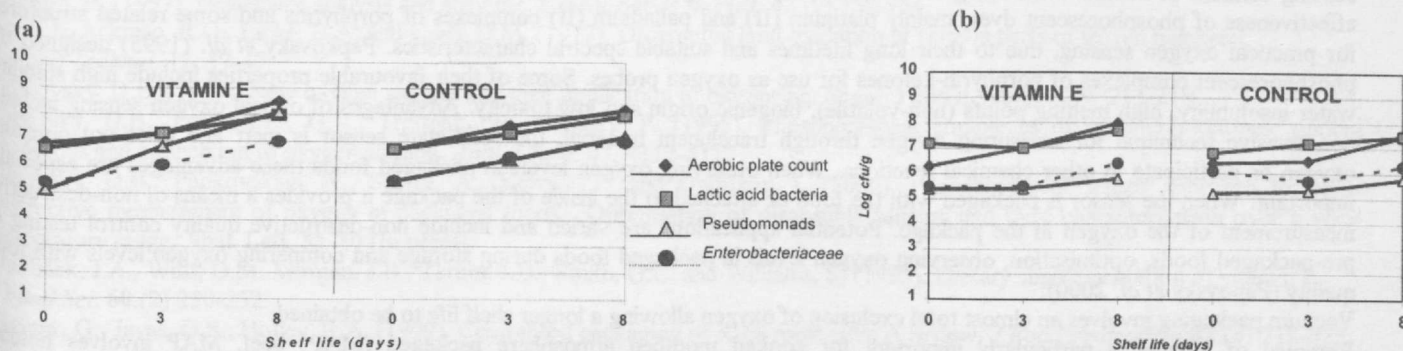


Figure 1 : Microbiological counts determined for minced beef displayed in PVC (a) and MAP (b) for up to 8 days at 4 °C from beef topside aged for 28 days in vacuum at 0 °C from cattle fed vitamin E supplemented or control diets.

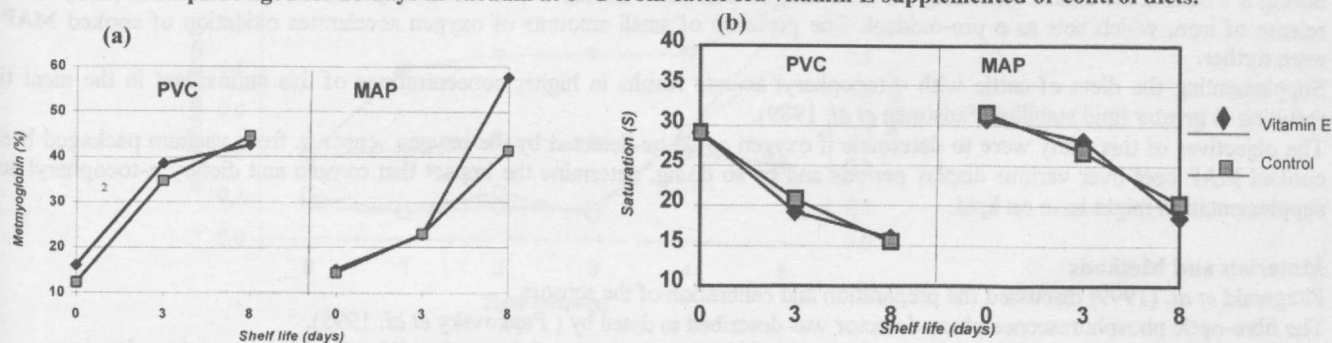


Figure 2 : Metmyoglobin accumulation (a) and saturation values (b) determined for minced beef displayed in MAP and PVC for up to 8 days at 4 °C from beef topside aged for 28 days in vacuum at 0 °C from cattle fed vitamin E supplemented or control diets.