IMPROVING THE SHELF LIFE OF CHICKEN PORTIONS USING MODIFIED ATMOSPHERE PACKAGING

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Background

In South Africa chicken portions are very popular. However, the current shelf life attained of less than 7 days is not adequate. While modified atmosphere packaging is being used to extend the shelf life of fresh pork and beef, this type of packaging method has not been extended to chicken. Since the initial count of processed chicken portions in South Africa is high, between log 5 – 6 cfu/g, successfully delaying the onset of microbiological spoilage may prove to be problematic.

Objective

To extend the microbiological shelf life of chicken portions with 100 % CO_2 and 20 % CO_2: 80 % O_2 modified atmosphere packaging.

Methods

Drumsticks from freshly slaughtered chicken were collected at a poultry abattoir and brought to the Meat Industry Centre (MIC), Irene with refrigerated transport at 0 °C. The drumsticks were packaged in boxes, approximately 4 kg of drumsticks in each box, protected by plastic inner bags. At the MIC the drumsticks were aseptically placed in polystyrene trays (Atlantic forming 69D/200, Darex Africa, Isando, South Africa), three drumstick per tray. Eighteen trays were flushed with 100 % CO_2 and 18 flushed with 20 % CO_2: 80 % O_2 using an Ilapak Delta 2000 packaging machine (Cryovac BDF foil, OTR - 20 ml/m^2/24h/atm at 23 °C & 75 % RH) (Darex Africa). Drumsticks were also placed on styrofoam trays and over-wrapped with polyvinyl chloride (PVC) (oxygen transmission rate (OTR) - *ca* 5 000 ml/m^2/24h/atm at 22 °C & 75 % relative humidity (RH)) to serve as a control.

All the PVC overwrapped drumsticks were displayed at 4 °C for a period of up to 7 days and the MAP treatment drumsticks for a period for up to 21 days in a Costan retail display cabinet (Hermagor, Austria).

After 0–7d and 0-21d of retail display the PVC and both MAP treatment samples were respectively assessed using microbiological and odour parameters. Aerobic plate, lactic acid bacteria, pseudomonad and *Enterobacteriaceae* counts were obtained. After each retail display period, a trained panel of 10 rated the odour of each opened MAP and PVC overwrapped pack. The scale ranged from 'no odour' (1), 'fresh meat' (2), 'slightly off' (3), 'moderately off' (4), 'strongly off' (5) to 'completely off odour' (6).

Results and discussion

The initial, day 0 of retail display, aerobic plate count of the PVC overwrapped drumsticks and the drumsticks from both MAP treatments ranged between log 5,4 – 5,8 cfu/g (data not shown). During the retail display period of 7 days a significant packaging x display period (p=0,0001) indicated that the 100 % CO_2 MAP treatment had significantly lower aerobic plate counts (log 5,6 cfu/g) than the 20 % CO_2: 80 % O_2 MAP treatment (log 7,5 cfu/g) and both MAP treatments recorded lower aerobic plate counts than the PVC samples (log 9,6 cfu/g) (data not shown). The odour panel also found that both MAP treatments still had no odour (1) at day 7 of retail display, while the odour of the PVC overwrapped samples was judged to be moderately off (4) (data not shown).

During the 21 day retail display period the aerobic plate count, pseudomonads and *Enterobacteriaceae* levels were significantly influenced by the packaging method (100 % CO_2 vs. 20 % CO_2: 80 % O_2) x retail display period (0-21d) interaction (p=0,0001) (Fig. 1). Although the initial, day 0 of display, aerobic plate count, pseudomonads and *Enterobacteriaceae* levels of both MAP treatments were similar the respective microbiological counts of the two MAP treatments increased at different rates during the 21 day retail display period. The aerobic plate count, pseudomonads and *Enterobacteriaceae* levels of the 20 % CO_2: 80 % O_2 MAP treatment increased more rapidly than that of the 100 % CO_2 MAP treatment during the 21 day display periods to reach levels of log 9,5; 8,9; 6,3 cfu/g respectively (Fig. 1). After 21 days retail display the aerobic plate count, pseudomonads and *Enterobacteriaceae* of the 100 % CO_2 MAP treatment were at levels of log 7,4; 5,3; 3,7 cfu/g respectively. Although the MAP treatments did influence the lactic acid bacteria level significantly (p=0,0284) during retail display (p=0,0001) the lactic acid bacteria count was similar for both MAP treatments at day 21 of retail display.

The odour of the 100 % CO_2 MAP treatments was still judged to be fresh (2) at day 21 of retail display, while the odour of the 20 % CO_2: 80 % O_2 MAP treatment was all ready found to be slightly off (3) at day 14 of retail display and moderately off (4) at day 21 of retail display (Fig. 2).

Conclusion

Modified atmosphere packaging can be successfully employed to improve the shelf life of drumsticks beyond the retail shelf life attained with PVC overwrap at 4 °C.

A modified atmosphere of 100 % CO_2 was more successful in inhibiting the growth of the pseudomonads and *Enterobacteriaceae* than the 20 % CO_2: 80 % O_2 MAP treatment. This was confirmed by the odour scores which indicated that the drumsticks packaged in 100 % CO_2 attained a shelf life of up to 21 days, while those packaged in the 20 % CO_2: 80 % O_2 only attained a shelf life of 14 days at 4 °C.

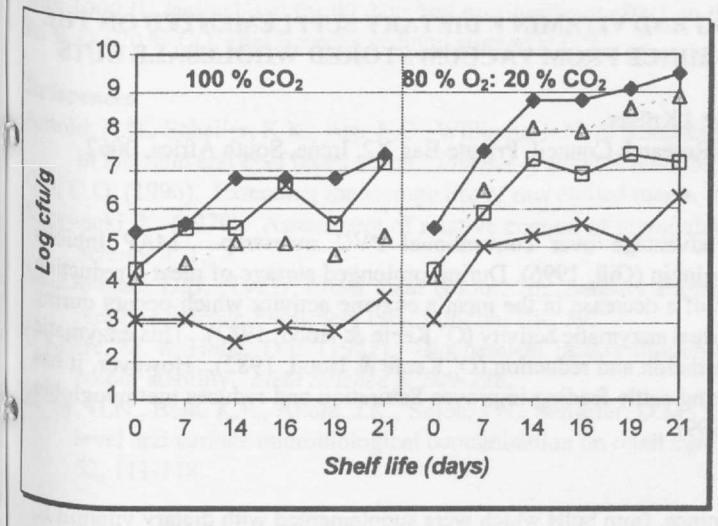

Figure 1: Microbiological counts determined for chicken drumsticks packed in modified atmospheres (100 % CO_2 and 80 % O_2: 20 % CO_2) and displayed for up to 21 days at 4 °C *(♦ Aerobic plate count;* ▲ *Pseudomonad count;* □ *Lactic acid bacteria count;* × Enterobacteriaceae *count)*

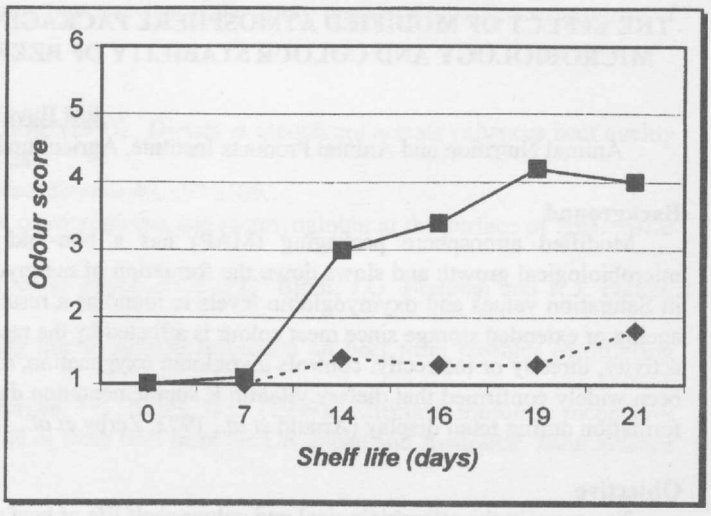

Figure 2: Odour scores for chicken drumsticks packed in modified atmospheres *(♦ 100 % CO; ■ 80 % O_2: 20 % CO_2)* **and displayed for up to 21 days at 4 °C** *(1=no odour; 2=fresh meat; 3=slight off; 4=moderate off; 5=strong off; 6=completely off)*