EFFECT OF PACKAGING AND ENDPOINT TEMPERATURE ON INTERNAL COOKED COLOUR OF PORK CHOPS MEASURED BY VIDEOMETERLAB 2

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Introduction

It is well documented that the chemical properties of myoglobin in meat affects the colour of cooked meat (Hunt *et al.*, 1999). Warren *et al.*, (1996) were the first to conclude, that the internal cooked colour can be related to the oxidative state of myoglobin present in meat prior to cooking. The oxidative state of myoglobin can be affected by the packaging procedure, e.g. when using modified atmosphere packaging containing oxygen nearly all myoglobin will be oxygenated forming oxymyoglobin. By adding carbon monoxide to the packaging atmosphere myoglobin will turn into carboxymyoglobin. Different pigment forms have different stability and denaturate at different temperatures. Metmyoglobin denatures at a lower temperature than oxymyoglobin, and deoxymyoglobin is the most heat stable myoglobin form of the three (Machlik, 1965). John *et al.*, (2004) found that meat packaged with carbon monoxide remains red until a temperature of 79°C, temperatures above the expected denaturation temperature for myoglobin. The objective of this study was to examine the effect of the packaging technique and endpoint temperature on the internal cooked colour of pork chops measured by a sensory panel and with VideometerLab2, a picture generating reflectance spectrophotometer.

Materials and Methods

Paired loins from six pigs with normal pH value slaughtered at a commercial slaughterhouse were selected. The loins were deboned, trimmed, sliced to a thickness of 2.5 cm, and packaged by three different packaging techniques. In each packaging the chops were randomly packaged with two neighbouring chops in a skin pack imitation, an oxygen MAP ($70\%O_2/30\%CO_2$), and a carbon monoxide MAP ($70\%N_2/30\%CO_2/0.4\%CO$). The skin pack imitation was made by putting the pork chops in shrinking bags under vacuum. Afterwards the bags were lowered in almost boiling water (approximately 85°C) and elevated after a few seconds. After packaging, the chops were placed in cold storage (4°C) for 7 days with retail display simulation for 12 hours the last day of the storage period. After storage, the pork chops were cooked to endpoint temperatures of 50, 55, 60, 65, 70, 75, and 80°C, turned every second minute on a 155°C hot frying plate. The internal cooked colour of the chops was evaluated by a trained 8 member sensory panel by determining the doneness on a 15 cm unstructured scale and afterwards measured with VideometerLab2 (www.videometer.com). The spectra from VideometerLab2, which are made of measurements at 18 discrete wavelengths, were evaluated in the Unscrambler software package (www.camo.com), version 9.2. Sensory data was evaluated in SAS (www.sas.com), version 9.1.

Results and Discussion

Results from the sensory evaluation are shown in Figure 1.

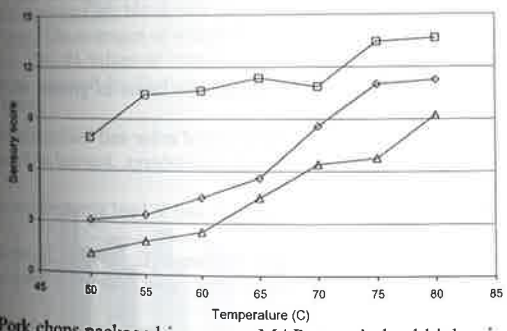

Figure 1: Least square mean values of the internal cooked colour of pork chops packaged using three different packaging techniques cooked to seven different end point temperatures. Packaging technique: ◊ skin pack; □ oxygen MAP; Δ CO MAP.

Pork chops packaged in oxygen MAP were judged higher in doneness than the pork chops packaged in skin pack and CO MAP at all endpoint temperatures. Furthermore, the skin packaged pork chops were rated higher than the pork chops packaged in CO MAP at all endpoint temperatures. As expected, increasing endpoint temperature reduces the red appearance of the interior of the pork chop. Pork chops packaged in oxygen MAP had a done appearance when cooked to an endpoint temperature of 50-55°C. Pork chops packaged in CO MAP and skin pack had to be cooked to an endpoint temperature of 75-80°C before appearing slightly done. These findings suggest that pork chops packaged in oxygen MAP have a tendency to brown prematurely, which is in agreement with the findings of Hunt *et al.*, (1999).

Furthermore, it is noticed that the pork chops packaged in CO MAP barely reaches a done appearance when cooked to 80°C, which are in agreement with the findings of John *et al.*, (2004).

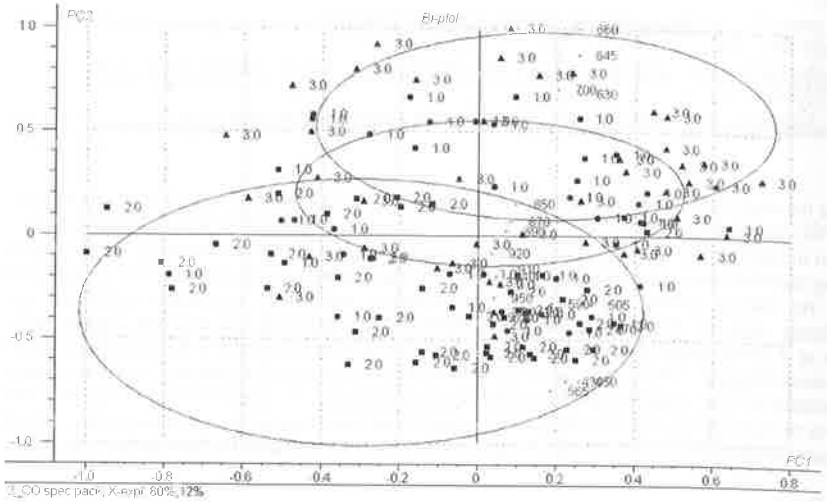

Figure 2: The Unscrambler bi-plot grouped according to packaging. No. 1: Skin pack; 2: O_2 MAP; 3: CO MAP. 3-figure numbers correspond to the measured wavelengths.

The bi-plot in Figure 2 is made by the Unscrambler and shows the spectra grouped according to packaging method. Basically all spectra from pork chops packaged in oxygen MAP (No.2) are located at the bottom of the plot (lower circle) together with the blue and green wavelengths (430-600 nm). The spectra from pork chops packaged in skin pack (No.1) (middle circle) and CO MAP (No.3) are located at the top of the plot (upper circle) together with the red wavelengths (600-700 nm). This indicates that generally the skin packaged and CO MAP packaged pork chops have a more red internal cooked colour than pork chops packaged in high oxygen MAP. Furthermore, the spectra from pork chops packaged in CO MAP are tilted in favour of the red wavelengths compared to the skin packaged pork chops indicating that they are more red in the interior than skin packaged pork chops after cooking.

An Unscrambler PLS analysis (partial least squares regression) shows a correlation between VideometerLab2 spectra with the sensory evaluation of doneness, which gives an r-value of 0.94.

Conclusions

VideometerLab2 is able to distinguish between pork chops packaged in three different packagings and cooked to seven different endpoint temperatures. Additionally there is good correlation between obtained spectra and the evaluation of doneness. It is noticed that the chemical state of the myoglobin form in the interior of the meat is of importance to the internal cooked colour, as concluded by Warren *et al.*, (1996) and furthermore, the chemical state of myoglobin can be influenced by packaging.

References

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