EFFECT OF SUBSTITUTION OF GRASS SILAGE FOR MAIZE SILAGE ON RETAIL PACKAGED BEEF QUALITY

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Backround

The main factors governing the eating quality of meat are tenderness, colour and flavour (Buckley *et al.*, 1995). Of the production factors affecting meat colour and quality, the dietary regime of the animals is one of the most important. Pre-slaughter dietary manipulation can have significant effects on meat quality as it effects meat composition (Wood and Enser, 1997) and therefore shelf life. Forage finishing of beef has produced mixed results on carcass characteristics and palatability attributes. Grass silage is the predominant forage in the diet of Irish beef cattle finished indoors. In recent years, there has been an increase in interest in the use of maize silage as complementary or alternative forage to grass silage in the diet of beef cattle. The objective of this study was to determine the impact of substituting grass silage with maize silage in the diet of finishing cattle on beef quality held under two forms of packaging; overwrapping and modified atmosphere packaging (MAP).

Materials and methods

Heifers (n=45) were randomly divided into 3 groups (n=15). Group 1 was fed maize silage *ad libitum* (MS), group 2 was fed 500g maize silage + 500 g grass silage/kg dry matter *ad libitum* (50:50 MS:GS) and group 3 was fed grass silage *ad libitum* (GS). Treatments included 3kg concentrates/animal/day. The duration of the feeding period was 167 days. Samples of *longissimus dorsi* (LD) muscle were vacuum packed and aged at 4°C for 2, 7 or 14 days postmortem and frozen at -30°C prior to analyses. Duplicate meat cores (2.5 cm diameter) and steaks (2.5 cm thick) were placed in polystyrene trays and overwrapped with O_2 permeable PVC film or packaged under modified atmosphere (MAP) conditions using a gas mixture of 80:20, O_2:CO_2. Colour analysis of meat cores was determined by measurement of Hunter "a" values using a Minolta Chromameter CR-300. The proportion of the pigment myoglobin was determined by the method of Krziwicki (1979). Sensory analysis (visual assessment) of beef was carried out by a semi-trained panel of 15 people. The extent of lipid oxidation over time was assessed using the 2-thiobarbituric acid method of Ke *et al.* (1977). α-tocopherol in muscle and feeds was extracted by the method of Sheehy *et al.* (1993) and quantified by HPLC. Total fat for fatty acid analysis was extracted from meat and feeds using the method of Folch et al. (1957). Fatty acid methyl esters were prepared according to the procedure of Slover and Lanzer (1979) and analysed by GC.

Results and Discussion

Although there was no overall significant difference in Hunter "a" values between meat from the three dietary groups held under both packaging conditions, trends showed that beef from the MS group had lower Hunter "a" values than the 50:50 MS:GS and GS groups (Figs 1 and 2). These findings contrast with those of Hoving-Bolink *et al.* (1999) who showed that meat from heifers fed a MS diet had higher Hunter "a" values than that from diets based on pre-wilted grass silage. Aerobic packed samples showed significant ($P<0.05$) differences in the proportions of metmyoglobin between the three dietary groups (Fig 1). The GS group had lower ($P<0.05$) proportions of metmyoglobin than the 50:50 MS:GS and MS groups. MAP samples did not show a significant effect on the proportion of metmyoglobin (Fig 2). In terms of overall colour, the visual panel most preferred the GS group and least preferred the MS group (Fig 3). Assessment of oxidative stability showed that the MS group had highest TBARS numbers while the GS group had the lowest TBARS numbers. This trend was observed in both aerobic and the MAP samples (Figs 4 and 5, respectively) for the duration of the trial, although TBARS numbers were highest for MAP samples. This finding was in agreement with Kerry *et al.* (1996) who showed that MAP promotes lipid oxidation in beef. The native vitamin E content of muscle has been shown to be a critical determinant of the susceptibility of muscle stored in high oxygen packs to lipid oxidation (O'Grady *et al.*, 1998). Muscle from GS diets had significantly higher ($P<0.001$) levels of α-tocopherol than 50:50 MS:GS and MS groups with values of 3.84, 2.95 and 2.08 μg/g meat, respectively. Previous studies have shown that accumulation of α-tocopherol in muscle tissues delays pigment and lipid oxidation (Houben *et al.*, 2000; Kerry *et al.*, 2000). It would appear that the results of this study are in agreement with such findings, as the GS group showed both the greatest colour stability and lowest levels of lipid oxidation, whereas the MS group showed the poorest colour stability and greatest level of lipid oxidation. Fatty acid composition of muscle from the three dietary groups differed only in the proportion of C18:3. Levels of C18:3 were significantly higher ($P<0.001$) in the GS group compared to the other groups. Beef from grass fed animals had better overall quality than beef from maize silage fed animals.

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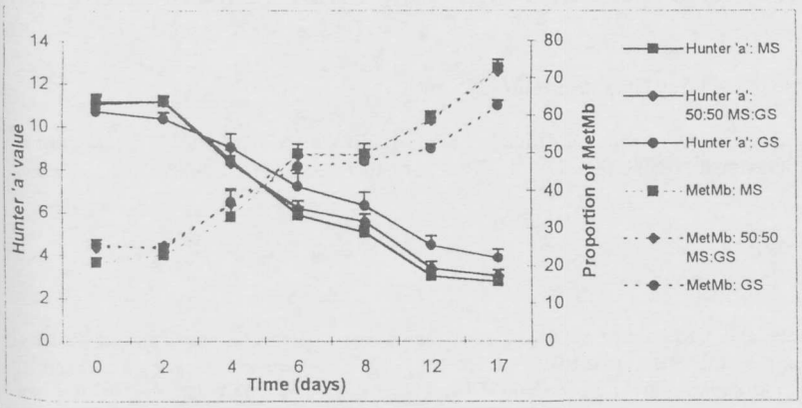

Figure 1. Hunter 'a' values and proportion of metmyoglobin (MetMb) in aerobic packed samples stored under display conditions at 4°C, 616 lux lighting for 17 days.
MS: Maize silage; GS: Grass silage.

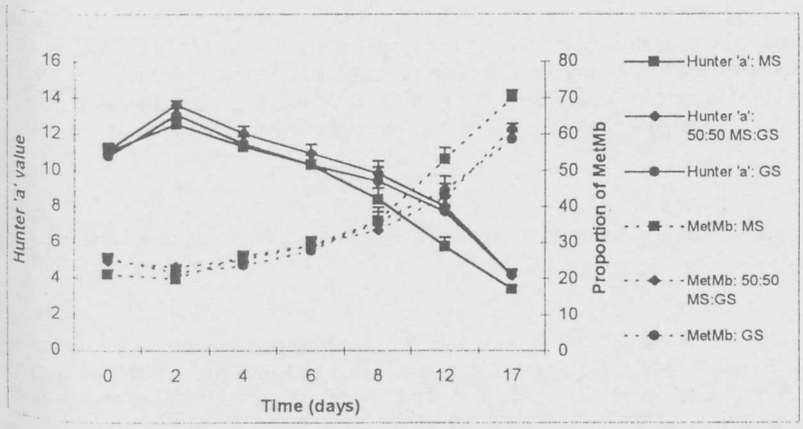

Figure 2. Hunter 'a' values and proportion of metmyoglobin (MetMb) in MAP samples (80:20, 0_2:$C0_2$) stored under display conditions at 4°C, 616 lux lighting for 17 days.
MS: Maize silage; GS: Grass silage.

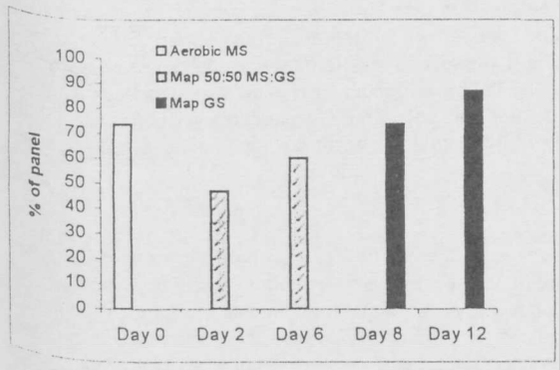

Figure 3. Panelist's overall preferred dietary group looking at both forms of packaging, aerobic and MAP (80:20, 0_2:$C0_2$). MS: Maize silage; GS: Grass silage.

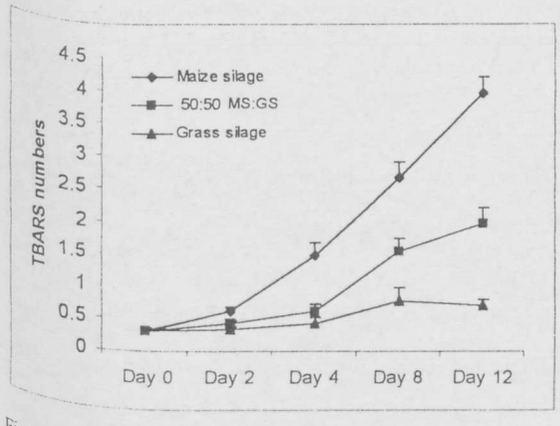

Figure 4. TBARS numbers for aerobic packed samples stored under display conditions at 4°C, 616 lux lighting for 12 days.

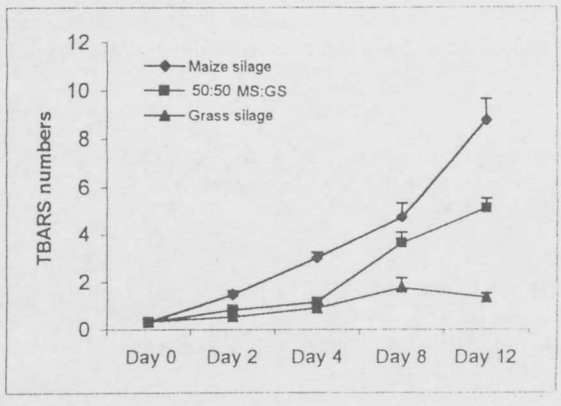

Figure 5. TBARS numbers for MAP samples (80:20, 0_2:$C0_2$) stored under display conditions at 4°C, 616 lux lighting for 12 days.