S8P06.WP

CONSUMER ACCEPTANCE OF RETAIL-PACKED BEEF FROM CONTROLLED ATMOSPHERE MASTER PACKAGINGS

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INTRODUCTION

Supermarket managements would realize considerable economic benefits if the meat offered for retail sale was prepared at central cutting facilities rather than in stores (Farris et al., 1991). Consequently, numerous commercial attempts have been made to institute systems for the central preparation of meat in display packagings. Those attempts have variously involved the rapid and frequent delivery to stores of conventional display packs, preparation of product in display packs containing a high-oxygen modified atmosphere, transport and storage of conventional display packs in master packagings containing a high-oxygen modified atmosphere, or vacuum packaged consumer cuts (Young et al., 1988). None of those systems has proved to be wholly satisfactory for all meat trades. Frequent delivery of conventional packages can be difficult to manage, while high-oxygen modified atmospheres do not, in many circumstances, sufficiently extend the storage life to allow for convenient delivers (Shay and Egan, 1990). In contract, vacuum packaging does confer an adequate storage life on product, but the purple colour of anoxic red meat has not proved acceptable to consumers (Allen, 1989).

There is thus need for a packaging in which display ready product can be stored for periods similar to those obtained with vacuum packs, but which will allow the displayed meat to show the bright red colour of meat surfaces that are freshly exposed to air. Those requirements may be met for beef by master-packaging display-ready packs under an atmosphere of oxygen-free nitrogen or carbon dioxide (Gill and Jones, 1993). The purpose of this study was to identify consumer reactions to beef steaks and ground beef that has been stored in such master-pack systems.

Meat was stored for three weeks before consumer testing, because a previous study of beef distribution had indicated that the commercial need to stockpile product against fluctuating consumer demand could result in such a time elapsing between packing at a slaughtering plant and retail display even when transportation times were short (Gill and McGinnis, 1993).

MATERIALS AND METHODS

A consumer panel of 120 people was recruited, to obtain a group distributed with regard to sex, age and family composition in proportions that approximated those of the population of Canada (Table 1). Names were selected at random from a local telephone directory. Persons were called in the order of the selection of their names. Respondents who indicated a willingness to participate, and whose sex, age and family circumstances corresponded with a vacant position in the panel, were recruited.

Vacuum packaged strip loins were obtained from a beef plant on days after the animals were slaughtered. The loins were stored overnight at 2°C. Each loin was then divided into three portions. One portion was vacuum packaged in a film that has an O_2 transmission rate of 40cc Q /m²/24 h/atm at 25°C and 100% r.h. (Barrier film; Cryovac, Mississauga, ON, Canada). The other two portions were each divided into three steaks, each 20mm thick. Each steak was placed on a solid polystyrene tray with walls 25mm high. Each filled tray was placed in a pouch of a shrinkable film that has antifogging properties and an O_2 transmission rate of 11000cc O_2/m²/24 h/atm at 25°C and 75% r.h. (RD 106; Cryovac). After being sealed, the pouch was shrunk to the tray using a hot air gun. A 3mm hole made in the film

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at one corner of the tray allowed the film to form as a flat lid to the tray.

The six consumer packs prepared from each loin were divided into two groups, and each group of three packs was master packed in a pouch composed of a gas impermeable aluminum foil laminate (American National Can Co., Meenah, WI, U.S.A.). One pouch was filled with 3l of N_2 and one with 3l of CO_2, using a packaging machine (Captron II; RMF, Grandview, MO, U.S.A.) that gives a pack atmosphere of either gas with a residual O_2 concentration of <500ppm.

The loin origin of the contained product was identified on each vacuum and master pack. All the vacuum and master packs were stored at 2°C for between 21 and 23 days.

Similarly, vacuum packs of beef trimmings were obtained from a beef plant on days that the trimmings were packaged. Each 10kg batch of trimmings was coarsely ground, then divided into three equal portions. One portion was vacuum packaged and the other two portions were finely ground then distributed into trays. Each tray contained 420±20g of ground beef. with the meat surface 5mm below the top of the tray walls. Each tray was packaged in the film of high oxygen permeability, and the consumer packs were master packaged, and stored, as for the steaks.

When product was to be distributed, the master packs and vacuum packs containing product from the same loin, or the same batch of ground beef, were withdrawn. The master packs were opened, and the product was held in air at -1.5°C for two hours, to allow the meat to bloom. Display packs of steaks or ground beef were prepared from the vacuum packaged product.

The samples were then distributed to panellists, over a period of between two and five hours. Each panellist received three steaks from the same loin, each steak having been subjected to a different storage treatment, and three packs of ground beef from the same batch, each pack having been subjected to a different storage treatment.

On delivery of a sample set, the accompanying questionnaires (Table 2) were explained to the panellist, and the portions of the questionnaires that dealt with the appearances of the display-packaged meats were completed by the panellist. The panellists were asked not to freeze the steaks, but to consume them within three days; and to store and prepare the ground meat as they would for purchased product, and to consume the ground meat within 14 days. Panellist were asked to note the method used for cooking each type of meat, and whether or not the ground beef had been frozen. If it had been frozen, panellists were asked to note the method used for thawing the ground beef. The panellists were also asked to note any comments they felt were appropriate at each stage of the assessments.

The completed questionnaires were recovered from each panellist. The responses to each question were tabulated, and the Chi squares test statistic was calculated for each table according to the SAS (1990) frequency procedure. Tables for which the probability of the chi squares test statistic were <0.05 were considered to show dependency of the response frequency on the storage treatment. Such tables were examined to determine the differences in the responses frequencies between the three storage treatments.

RESULTS AND DISCUSSION

For steaks, the frequencies of responses to the three storage treatments differed significantly only for the questions on the colour of the retail packaged meat and the perceived amount of exudate in the unpackaged meat (Table 2). In response to the question on packaged meat colour, >90% of the panellists considered the colour of all steaks to be "just right", but 6% considered steaks that had been stored under N_2 were "too dark" while 6% considered steaks that had been stored under CO_2 were "too light". In response to the question on exudate in unpackaged steaks, <80% of the panellists considered all steaks to be "about right", but steaks from the vacuum, N_2 and CO_2 storage treatments were considered "to wet" by respectively 6, 12 and 11% of the panellists.

For ground beef, the frequencies of the responses to the three storage treatments differed significantly or highly significantly, for the questions on the general acceptability, exudate and colour of packaged meat, the exudate in

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unpackaged meat, and the general acceptability of the cooked meat (Table 2). The general acceptability of the packaged meat from vacuum, N_2 and CO_2 storage treatments was considered "good" or "very good" by respectively 95, 90 and 84% of the panellists, but "fair" by respectively 2, 6 and 12% of the panellists. Packaged meat from vacuum, N_2 and CO_2 storage treatments was considered "too wet" by respectively 6, 11 and 27% of the panellists, and "too dark" by 4, 21 and 12% of the panellists.

The ground meat was frozen by 85% of the panellists. After thawing at room temperature (54%), in a refrigerator (28%) or by microwave heating (18%), the unpackaged meat from the vacuum, N_2 and CO_2 storage treatments was perceived to have "little exudate" by respectively 41, 24 and 24% of the panellists.

The ground meat was grilled or fried by 60% of panellists, with the remained preparing some boiled or baked dish. The meat from the vacuum, N_2 and CO_2 storage treatments was considered "poor" or "very poor" by respectively 10, 2 and 3% of the panellists. It was apparent from the panellists volunteered comments that the poor scores for eating quality arose when the meat was perceived to have off flavours.

The results indicate that some may perceive a difference between the colours of steaks freshly cut from vacuum packaged product or stored in retail packs under an N_2 or CO_2 atmosphere, and that a greater amount of exudate is likely to be apparent when steaks are stored in retail packs rather than freshly cut from vacuum packaged product. However, any colour differences arising from the storage treatments would seem to be small, as a large majority of the panellists perceived none, while the perception of excessive exudate could be prevented by the use of an absorbent of adequate capacity. Proper attention to the retail packaging should then result in retail-ready steaks stored under anoxic atmospheres having consumer-perceived attributes that do not differ from those of steaks freshly cut from vacuum packaged product.

More panellists discriminated between the ground beef than the steaks on the basis of the storage treatments. However, the perception of excessive exudate in retail packs stored under anoxic atmospheres could again be prevented by the proper use of an exudate absorbent. Moreover, the difference in colour between the freshly ground beef and the product stored in master packs appeared to be, at least in part, an artifact of the experimental procedure. The storage in vacuum pack of coarsely ground trimmings resulted in the fat tissue being stained with exudate. The pale pink fat in the finely ground product tended to lighten the perceived red colour of the mass. In contrast, the fat in the master packaged product remained white, so the red colour perceived was that of the darker muscle tissue alone. That type of difference does not arise when, as is usual in commercial practice, beef for grinding is stored as vacuum packaged trimmings that are finely ground shortly before display. The coarse grinding of product, with its subsequent storage in a packaging of low, but measurable, oxygen transmission might also be responsible for the flavour deterioration that some panellists noted in the product that was stored in vacuum packs. The advantage to ground beef flavour of master packaging under anoxic atmospheres might not then be so marked in practice as this study would seem to indicate.

Despite some uncertainties over details, there seem little doubt that steak and ground beef in suitable retail packs could be master packaged under atmospheres of N_2 or CO_2 to yield, after storage for up to three weeks at 2°C, product that would be acceptable to a large majority of consumers. Master packing under anoxic atmospheres could then offer a practicable means of preserving retail ready beef for distribution throughout a continental market.

ACKNOWLEDGEMENTS

REFERENCES

ALLEN, J.W., 1989. Centrally prepacked fresh red meat: success or failure? *Nat. Prov.* 201(6):8-10.

FARRIS, D.E., DIETRICK, R.A., and WARD, J.B. 1991. Reducing the cost of marketing beef. *Meat Proces.*

30(2):60+62.

GILL, C.O., and JONES, T. 1993. The display of retail packs of ground beef after their storage in master packages under various atmospheres. *Meat Sci.* (in press).

GILL, C.O., and MCGINNIS, C. 1993. Changes in the microflora on commercial beef trimmings during their collection, distribution and preparation for retail sale as ground beef. *Int. J. Food Microbiol.* (in press).

SAS. 1990. *SAS/STAT User's Guide.* Version 6, 4th eition. SAS Institute Inc., Cary, NC.

SHAY, B.J., and EGAN, A.F. 1990. Extended retail storage life of beef and lamb by modified atmosphere packaging. *Food Australia.* 42:399-400+404.

YOUNG, L.L., REVIERE, R.D., and COLE, A.B. 1988. Fresh red meats: a place to apply modified atmospheres. *Food Technol.* 42(9):65-68.

Table 1. The composition of the consumer panel that evaluated beef samples.

Group	Number
Men without resident family (19-60)	10
Women without resident family (19-60)	10
Men over 60 (with or without resident spouse	16
Women over 60 (with or without resident spouse)	20
Family with a child <10	31
Family with a child/children >10, no children	33

Table 2. The probability of the Chi squares test statistic calculated for the tabulated responses of consumer panellists to each question on meat quality. Meat was stored in vacuum packs before being prepared for display, or was retail packaged and stored in master packs under an atmosphere of N_2 or CO_2. Panellists were presented with sets of steaks and sets of ground been, each set containing product from each of the storage packagings and completed separate questionnaires for each set.

Question	Probability Steaks	Ground beef
Packaged meat		
General acceptability	0.266	0.024[a]
Exudate	0.465	<0.001[b]
Colour	0.010[a]	0.003[a]
Fat content	0.682	0.155
Unpackaged meat		
General acceptability	0.674	--
Odour	0.445	0.458
Exudate	0.026[a]	0.005[a]
Colour	0.315	0.727
Fat content	0.514	0.225
Cooked meat		
General acceptability	0.163	0.003[a]
Odour	0.805	--
Tenderness	0.983	--
Flavour	0.753	--
Fat content	0.673	--

-- = question not asked for ground beef.
[a] = significant difference between the responses ($P \leq 0.05$).
[b] = highly significant difference between the responses ($P \leq 0.01$).