Consumer preferences for retail packaged beef steaks with or without oxygen - a Danish in home cooking study

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Abstract

A total of 382 consumers from 200 families in Roskilde (80,000 inhabitants) answered questionnaires after cooking and eating two meals at home of beef steaks supplied in different packaging forms. Left and right striploins from 11 cows, 8 heifers and 1 steer (17-80 month, 239-315 kg carcass weight, EUROP conformation (P^+, O^-) and fat class (3-4) were vacuum aged at 2ºC for 14 days. Striploins were then sliced into steaks which were 2 cm thick and MA packed without oxygen in either 70% N_2, 30% CO_2 (0-Ox) or 69,6% N_2 , 30% CO_2, 0,4% CO (0-Ox-CO) or with high oxygen 80% O_2, 20% CO_2 (Hi-Ox). Steaks were assigned for two consumer meals comparing Hi-Ox in both meals combined with either 0-Ox or 0-Ox-CO. Steaks from the left or right side at similar striploin positions were packed in either gas combinations, stored for 3 days at 2ºC before consumers collected and subsequently cooked the steaks to their own standardized preference on day 4-7 after MA-packaging. The questionnaires showed that consumers were able to distinguish quality differences between packaging methods. They rated tenderness, juiciness, flavour and overall liking higher for steaks packed without O_2, irrespective of consumer age and sex. There was no difference in quality perception after cooking between the two types of O_2 free packs. A high proportion of consumers found Hi-Ox cooked steaks to be overdone.

Introduction

An increasing amount of beef is marketed in Hi-Ox modified atmosphere (MA) packs providing the advantage of longer shelf life with acceptable colour. Case ready meat packaging offers advantages for central packaging, distribution and retailers with a more time flexible delivery of fresh meat to consumers who also gain from a more flexible consumption pattern and less need to buy fresh meat frequently. It is, however, important to use packagings that preserve quality during storage regarding both shelf life and eating quality.

Sensory panel studies have demonstrated that the sensory properties like tenderness and juiciness may decrease during storage in MA with high oxygen, and that oxidized flavour, like warmed over flavour (WOF), may increase (Seideman et al., 1979, Tørngren, 2003; Clausen, 2004; Sørheim et al., 2004, Madsen & Clausen, 2006). MA with high O_2 also increases the amount of oxymyoglobin, which gives rise to a well-done appearance at lower temperatures (Hunt et al., 1999). An alternative to Hi-Ox is a combination of CO_2, N_2 and CO. CO_2 is added to the gas mixture because of its anti microbiological properties (Jakobsen & Bertelsen, 2002) which increases shelf life. N_2 is an inert gas, but beef will appear purple (deoxymyoglobin), if O_2 is completely excluded from the gas mixture, or brown (metmyoglobin) if a little O_2 (½-1%) is left in the pack. Small amounts of CO (0.4%) gives the meat the desirable shiny red colour corresponding to meat exposed to O_2. The European Commission (2001) estimates that adding 0.3-0.5% CO in a gas mixture does not constitute any health risk. Presently, it is not on the list of accepted gas combinations, as it has been in the USA since 2004, where the use is still debated. An exemption was granted for this study.

The ultimate decision on acceptable packaging systems lies with the consumer. Any large change in visual appearance needs not only substantial communication, but also an associated perceived increase in eating quality. Therefore, the question is to which extent the consumers - under home cooking conditions - are able to differentiate and have different preferences for the eating quality of beef steaks packed with different packaging concepts. In this consumer study, the perceived eating quality of retail packaged beef steaks with or without O_2 was investigated.

Material and methods

The vacuum packed striploins (M. longissimus dorsi) for the experiment were sampled at a commercial slaughterhouse from animals of an average age of 37 month. The meat was stored at 2°C for 14 days prior to steak slicing and assignment of adjacent steaks to the packaging systems in table 1. The steaks were packed alternating from the left and the right loin to 0-Ox/CO and Hi-ox packs. Steaks from different animals but from the same loin position were packed for the two meals, where half of the consumers tested 0-Ox-CO on day 1 and the other half 0-Ox and vice versa on day 2.

MA-packs were stored for 3 days at 2°C before collection by consumers (packed as 2x2 steaks) who were instructed to eat the steaks in two meals within 4-7 days after packaging.

Table 1. Packaging systems on beef steaks compared by consumers in Roskilde

	70%N_2, 30%CO_2	69,6%N_2 , 30%CO_2, 0,4%CO	80% O_2, 20% CO_2
Day 1- Meal	0-Ox		Hi-Ox
Day 2 - Meal		0-Ox-CO	Hi-Ox

Ready mixed gas from Yara Praxair and AGA was used in a Multivac T200 top seal packaging machine, with Apet (13x18x4 cm) trays M71-51A (O_2-: Max. 2 cm^3/m^2 x 24 x bar, Færch) with Topseal TM MAP AF 57 (O_2- permeability: Min. 100 cm^3/m^2 x 24 x bar, Færch).

200 families from the Roskilde area who eat beef frequently were recruited in three age groups (18-30; 31-55; 55-92) by a professional bureau. Consumers collected the case ready packs at DMRI where they were given a short instruction that the meat was safe to eat irrespective of visual appearance. Consumers were instructed to store the meat in their refrigerator and to cook the steaks to their own liking in combination with condiments by choice. The only demand was that cooking of both steaks should by identical also in both meals. A photo guide explained how to trace steaks during cooking with enclosed coloured labels, and how to cut and serve ½ a steak from each MA-pack on the same plate.

Questionnaires for both meals accompanied the packs and included marking of: Overall liking, and liking of tenderness, juiciness and flavour on a 10 cm unstructured line anchored to extremes. The degree of doneness should also be marked on a 10 cm line illustrated by 5 photos of cooked steaks ranging from red to brown, and in addition the consumers were asked to indicate if the steak was cooked too rare, adequate or overdone. Furthermore, the consumers were asked to mark if they were willing to pay less, the same, or more than for steaks they would usually purchase. At the second meal they were also asked to indicate which of the four steaks they would choose. Two persons in the family answered the questionnaire in each meal.

The preference data was analyzed in SAS Ver. 9.1.3 with the following model, in which the effects with capital letters were analysed as random:

Liking = packing method(animal) + gender + age group + packing method(animal)*gender
+ packing method(animal)*age group + FAMILY*PACKCOMB(animal) + ε

Where: packing method=1..4 animal=1..20 and packcomb=1..10 eg. the combination of the two animals distributed to a household.

Results and discussions

A total of 382 consumers (96%) answered the questionnaires with main results shown in table 2. Both for overall liking and individual quality traits, the packs without O_2 had the highest preference. This was irrespective of the sex and age of the consumers. There was no difference perceived between the packs without O_2. The consumer results from in home cooking situations overall confirm previous results from studies with sensory panels in which Hi-Ox results in decreased tenderness, juiciness and increased oxidized flavour.

Most consumers were willing to pay the same for the steaks as for steaks commonly purchased, irrespective of packaging (Fig. 1). However, about 20% were willing to pay more for steaks packed without O_2, whereas only about 10% would pay more for Hi-OX packs and up to 30% indicated they would pay less for Hi-Ox packs.

After the two meals, consumers could indicate which of the four steaks they would like to purchase, Fig 2. The question is more complicated and requires that they remember or look into records from the previous meal or make their judgement only on the background of the meal just consumed. Thus 13% did not answer the question, but the answers show that about 2/3 would prefer to buy steaks without O_2 and only 1/3 would prefer to buy Hi-Ox steaks.

About 30% of the consumers indicated that steaks were cooked as overdone for Hi-Ox packs whereas only about 10 % indicated this for packs without O_2. Similarly, the marking of doneness on the intensity scale showed that steaks packed without O_2 were judged as more red in the centre, about 5.6 as compared to 7.1 for Hi-Ox steaks.

Table 2. Consumer liking of beef steaks packed with or without oxygen

Consumer questions \ Packaging	70% N_2, 30% CO_2	80% O_2, 20% CO_2	80% O_2, 20% CO_2	69,6% N_2, 30% CO_2, 0,4% CO	Std.err.
	0-Ox	Hi-Ox	Hi-Ox	0-Ox-CO	
How do you like the steak?[1]	6.3^{a}	5.4^{b}	5.6^{b}	6.2^{a}	0.2
How do you like the tenderness?[2]	6.8^{a}	6.0^{bc}	5.9^{c}	6.5^{ab}	0.2
How do you like the juiciness?[2]	6.8^{a}	6.1^{b}	6.1^{b}	6.9^{a}	0.2
How do you like the flavour?[2]	7.1^{a}	6.3^{b}	6.4^{b}	6.8^{a}	0.2

Different row letter indicates that the mean is significant different by at least 0.05 % level $p<0.05$
[1] Extremes:0 – not at all, 10 – really like, [2] Extremes:0 – Very poor, 10 – Very good

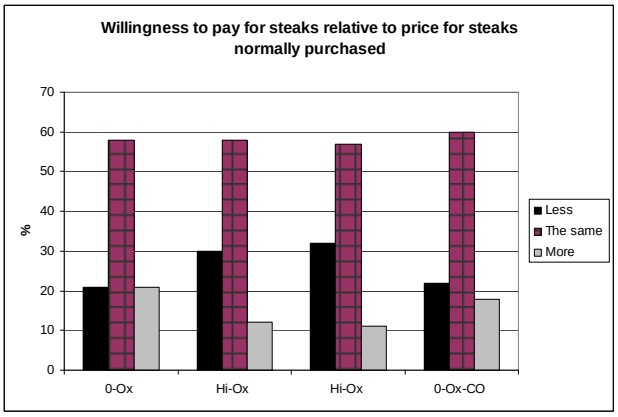

Figure 1. Payment willingness**.**

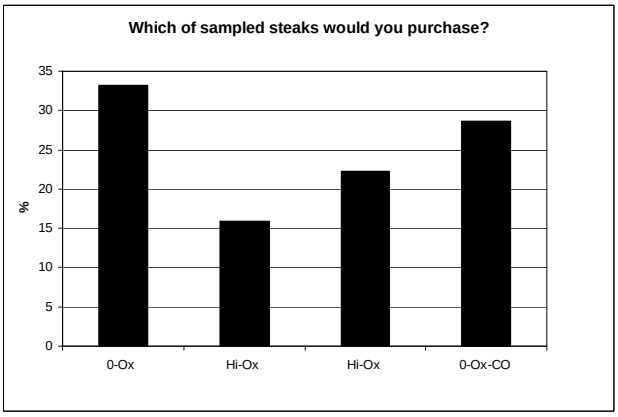

Figure 2. Preferred steak choice.

While the results are convincing with respect to perceived quality it should be remembered that they are only indicative for consumer perception of the cooked meat quality, and not for actual purchase behaviour. The visual appearance of the fresh meat colour is a significant quality parameter. With the distinct colour differences of the different packs in this study it is likely that substantial marketing and communication are necessary for the 0-Ox packs to achieve similar purchase willingness as for the Hi-Ox packs with the colour presentation that consumers are more accustomed to.

Conclusions

It is concluded that consumers in Roskilde - for in home cooked meals - were able to differentiate eating quality of MA-packed steaks with or without O_2. There was both a higher overall liking and a higher liking for the quality parameters tenderness, juiciness and flavour of packs without O_2. Furthermore, for steaks packed without O_2 there was a similar preference with or without 0.4% CO.

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