FACTORS IMPACTING ON CONSUMER'S PERCEPTION OF LAMB COLOUR

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***Abstract*— Consumers (n = 541) were asked to score 10 samples of lamb loin (m. *longissimus thoracis et lumborum*; LL) on an ordinal scale of 1 (very acceptable) to 5 (very unacceptable). A sample was considered acceptable by a consumer if it scored three or less. The samples were used for testing consumer response to colour during extended display of up to 4 days. A Hunter Lab Miniscan was used for measuring meat on display. Respondents were also asked whether or not they considered the level of iron and omega-3 in lamb to be important. Results of the analysis indicated that L* (lightness) and b* (yellowness) were not significant (*P* > 0.05) after adjusting for days aged, a* (redness) and wavelength ratio (630/580nm) and there were no significant (*P* > 0.05) interactions between gender, iron and omega-3. The effects associated with sex, iron and omega-3, after adjusting for sample differences as accounted for by days aged, a* and ratio, were signficant at the P = 0.05 level. Respondents who indicated that the level of iron is important scored the same piece of lamb lower (more favourable colour) than those that indicated it was not important. The opposite effect was observed for omega-3, with those that indicated the level of omega-3 was not important scoring the same piece of lamb lower (more favourable colour). Consumers altered their tolerance to the browning of lamb meat, dependent on the importance they placed on the levels of iron in the meat.**

***Index Terms*—consumers, lamb, colour, iron, omega-3.**

I. INTRODUCTION

The colour of meat is an extremely important factor that influences a consumer's purchase decision as it is deemed a visual measure of freshness and quality (Faustman & Cassens, 1990). Meat discoloration caused by the accumulation of metmyoglobin limits the shelf life after retail preparation (Jeyamkondan, Jayas & Holley, 2000); this is a significant economic issue for the meat industry. Knowledge of consumer's perception of meat colour is important in the development of efficient methods for enhancing initial colour and colour stability so as to satisfy consumer demand. In a recent report it was shown that gender of the consumer impacted on the perception of colour acceptability such that females assessed the same samples more severely than males when examining lamb which had been on simulated retail display (Khilji, van de Ven, Lamb, Lanza & Hopkins, 2010). With an increase in the importance of nutritive traits for lamb (Hopkins, Jacob, Ball & Pethick, 2009) the impact of consumer's attitudes towards omega-3 and iron levels was examined for any flow on effect on colour perception of lamb during retail display.

II. MATERIALS AND METHODS

A survey of 541 consumers was conducted in 2 Australian cities, Canberra and Dubbo, over a number of consecutive days. In Canberra the survey was conducted over 4 days at a meat retail outlet, whereas at Dubbo it was conducted over 3 days at an agricultural fair. To minimise the bias the same refrigerated cabinet was used and the same 2 interviewers conducted all interviews in the 2 cities. Consumers were asked to answer questions in 2 sections;

Section -1 - Demographics: including gender, age class, whether the respondent consumed lamb (and if they did how many times per week lamb was consumed), did they purchase lamb, is the level of iron important and is the level of omega-3 important.

Section -2 - To assess 10 lamb loin (m *longissimus thoracis et lumborum*; LL) samples. These samples were a 2-3 cm cross section of the muscle with no bone or subcutaneous fat. Respondents were asked to score each sample on a 1 to 5 ordinal scale with 1 = very acceptable, 2 = acceptable, 3 = mildly acceptable, 4 = unacceptable and 5 = very unacceptable.

Four days before commencement of surveying, 2 lamb LL samples from 2 different animals were purchased and one slice (3 cm thick) was cut from each lamb LL sample, across the muscle, and displayed on black foam trays (13.5 cm x 13.5 cm) over wrapped with PVC food film wrap (15 μm thickness) and held in the refrigerated cabinet. The

remainder was vacuum packaged and held chilled at 3-4ºC and the procedure repeated on the next 2 days. On the day before surveying 2 new LL samples from 2 different animals were sliced to provide further slices and on the third day of surveying another 2 new LL samples from 2 different animals were used to provide slices. Thus on each survey day, 10 samples of LL were on display (representing 0, 1, 2, 3, 4 days of display). At the end of each survey day the oldest pair (displayed for more than 4 days) were discarded and replaced by a fresh pair (0 days displayed).

Meat colour (L*, a*, b*) and the ratio (630/580nm) were measured after a blooming period of 30-40 min and re-measured in the middle of the day, using the Hunter Lab Miniscan (Model 45/0-L) with an aperture size of 25 mm. The instrument was calibrated with black and white tiles using Illuminant D-65 with 10 degree standard observer. These samples were displayed under the same conditions as those for the fresh colour samples.

The proportional odds model (cumulative logit models for ordinal responses) was fitted using ASREML3 (Gilmour, Gogel, Cullis & Thompson, 2006). Here the model for an observed consumer score (1 to 5), assumed to be a multinomial response taking on one and only one of the possible responses 1, 2, 3, 4 or 5, is

$$\text{logit}\,[\,\Pr(\text{Score} \le j)\,] = \alpha_j + \text{fixed effects} + \text{random effects} \qquad (j = 1, 2, 3, 4)$$

$$\text{with logit}\,[\,\Pr(\text{Score} \le j)\,] = \log\left(\Pr(\text{Score} \le j) / (1 - \Pr(\text{Score} \le j))\right)$$

The fixed effects in the model included the number of times lamb is eaten per week, as well as factors for gender (Male or Female), age class (<20, 20-30, 30-40, 40-50, 50-60, >60) of the respondent, and the response of the respondent to whether both omega-3 and iron levels were important to them. Covariates included L*, a*, b*, ratio and the number of days aged and the random effects included were city (Canberra or Dubbo), survey day within city, sample, responder, the number of days a sample was aged as a factor (denoted by *fdays*) and interaction effects for *fdays* with each of city, sample and respondent. The inclusion of the terms number of days aged, L*, a*, b* and ratio in the model as fixed effects is to adjust samples as much as possible so that comparisons of results across combinations of gender, iron and omega3 are adjusted for differences in samples scored.

III. RESULTS AND DISCUSSION

Analysis of responses was restricted to respondents who anwsered the question about the importance of iron and omega-3 and this distribution is shown in Table 1 according to city.

Table 1. Distribution of consumer responses to the question about the importance of iron and/or omega 3's

	Iron		Omega 3's	
Important	Canberra	Dubbo	Canberra	Dubbo
No	61	80	74	97
Yes	179	171	166	154

Results of the analysis indicated that L* and b* were not significant ($P > 0.05$) after adjusting for days aged, a* and ratio and there were no significant ($P > 0.05$) interactions between gender, iron and omega-3. The effects associated with gender, iron and omega-3, after adjusting for sample differences as accounted for by days aged, a* and ratio, were signficant at the P = 0.05 level. It has been previously reported that gender, a* and ratio all had a significant affect ($P < 0.05$) on the scores given by respondents for colour (Khilji et al., 2010), but here we report that the attitude of the respondent to the importance of omega-3 and iron levels in lamb also impacted on colour scores. Respondents who indicated that the level of iron was important scored the same piece of lamb lower (more favourable colour) than those that indicated it was not important. The opposite effect was observed for omega-3, with those that indicated the level of omega-3 was not important scoring the same piece of lamb lower (more favourable colour) than those that indicated it was not important as shown in Figure 1.

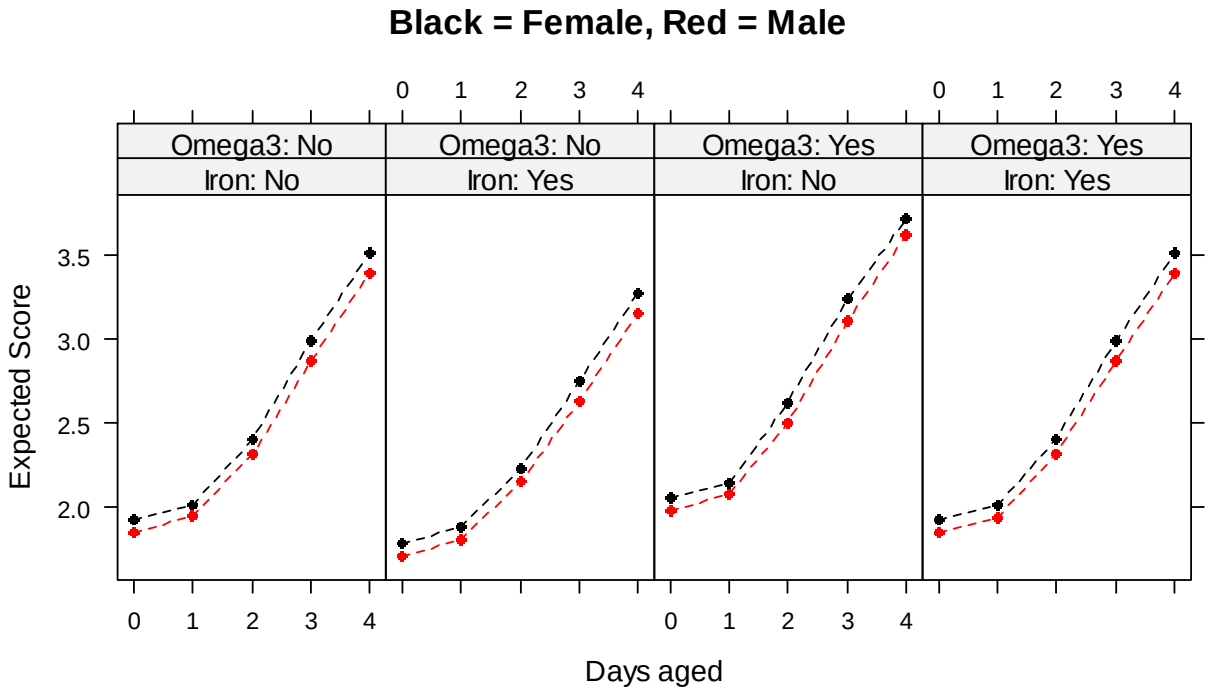

Fig. 1. Estimated expected colour score for females and males according to their response of the importance of iron and omega-3 levels.

This outcome suggests that the consumers value the intake of iron sufficiently to lower their tolerance towards the degree of metmyoglobin or brownness development, but this is not the case for omega-3's. It may also reflect the standing that lamb has as a good source of iron. For example the current data suggests that a 135 g serving of lean lamb contains 2.7 mg of iron (Willams, 2007) with the recommended dietary intake (RDI) in Australia being 8 for all men and for women over 50 years of age. Since a 'good source' is considered to provide 25% of the RDI, lamb provides a good source of iron for a large segment of Australian consumers and this fact is widely promoted (http://www.mla.com.au/TopicHierarchy/InformationCentre/Red+meat+and+nutrition/News+and+information/Nutrients+in+red+meat.htm). By contrast promotion of the health benefits of lamb for omega-3's has direct competition from fish which have higher levels of the health claimable EPA and DHA (Howe, Buckley & Meyer, 2007) and it is possible that consumers are not prepared to accept lower levels of tolerance for discolouration on the basis of the perceived benefit for omega-3's from lamb.

IV. CONCLUSION

Consumers have been shown to alter their tolerance to the browning of lamb meat, dependent on the importance they place on the levels of iron in the meat. This is not the case if omega-3's are perceived to be important and this likely reflects that they do not perceive lamb as a sufficiently important source of omega-3. Such subtle interactions demonstrate the challenges of retailing meat to consumers who are constantly bombarded with the health benefits of various food products.

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