factsheet

Pork Information Gateway

Consumer Attitudes Towards Color and Marbling of Fresh Pork

Author
Dr. Susan Brewer, University of Illinois

Reviewer
Dr. Dustin D. Boler, The Ohio State University
Dr. Steven J. Moeller, The Ohio State University

Defining Color

Humans use color to judge the 'value' or quality of a product, often comparing and choosing a product based on expectations and past experiences. Choices made based on visual evaluation, which requires no physical contact, pose very little risk; therefore, when a product does not meet 'color expectations', it is an easy decision deem a product 'unacceptable'. Color is produced when energy in the visible range (400 to 700 nm) is perceived by the eye (Hunter 1986). The energy that produces color is contained in light. 'Pigments' are molecules that absorb (subtract) some of the wavelengths from the light that illuminates an object. Wavelengths of the light that are absorbed are not observed whereas the wavelengths of light that are reflected produce the color we see. In order for a 'color' to be visible, it must be contained in the reflected light, meaning the 'color' must be present in the original light directed at the object Both the pigments in the product and the light directed at the product determine how color of the object appears.

Fresh meat color is also affected by the amount of water in or on the meat. Proteins in meat with a low ultimate pH (< 5.4) do not bind water very tightly; therefore, the "free water" in the tissue reflects or scatters light in many directions making the meat appear pale. As pH of meat increases, water is more tightly bound and the color becomes progressively darker.

Color influences purchasing decisions as to whether a food is acceptable for consumption so measuring color is important to the industry. Color can be measured using human visual assessments or instrumental systems that closely parallel the way that the human eyes 'see' color. When evaluating a range of colors, consumers can detect a difference, and most will give similar answers because they see color similarly. However, when consumers are asked what they prefer or if they would purchase an individual product, they often give very different answers.

Measuring color or color differences in meat products may be somewhat easy, but understanding the specifics that drive a consumer to like or dislike, buy or not buy is often more difficult (Brewer, 2009). Knowing a color difference exists provides little information, unless there is a defined ideal or preferred color range for a particular product. Preferred color of meat products is commonly determined by polling a large group of consumers. However, consumer research also identifies extraneous factors such as geographical region of the country, age of the consumers, and past experience with the product, that may, and often do, impact the preferred color characteristics. While extraneous factors can be accounted for when identifying the ideal; the influence of extraneous factors also constitute an important part of the consumer preference story.

The color of red meat (beef, pork, lamb) is due primarily to myoglobin, the pigment which stores oxygen until it is needed in the muscle tissue. Color of red meat changes over time as the pigments bind oxygen (purple to red or pink) and then ultimately change to brown or grey following oxidation. Color also changes due to microbial growth, cooking, and exposure to added ingredients (vinegar, salt, etc.). \Consumer Attitudes Towards Fresh Pork Color

Appearance is a major factor in a consumer's decision to purchase pork (Brewer et al. 2002a). Sensory traits that consumers identify as important to the visual expectation or eating experience of the product include color, marbling, taste, juiciness and tenderness (Meisinger, 2001). Ngapo et al. (2010ab) reported that fat cover and color were the most important selection criteria used by consumers choosing pork. However, color is often considered to be the most important intrinsic quality cue for fresh pork (Glitsch, 2000). Ngapo et al. (2010b) found two preference-based clusters: 41% preferred dark red, lean meat and 59% preferred light red, lean meat, without marbling or drip.

In general, consumers base their choice of pork on color and level of fat rather than marbling and drip loss, with most preferring leaner samples (Ngapo et al., 2010a). Because over one-half of consumers in their study purchased packages of normal-colored pork while <25% chose PSE and <25% chose DFD pork, Wachholz et al. (1978) suggested that some consumers may be aware of and may actively select for "normal" pork color, but that others are either unaware of the limitations of, or do actually prefer, PSE and DFD pork. Brewer and McKeith (1999) reported consumers had no difficulty differentiating color of pork loins from a tested range of pale (L* = 57) to dark pink (L* = 38). Small changes in overall visual appearance acceptability resulted in greater changes in purchase intent of lighter-colored pork than in darker-colored pork (Table 1). Norman et al. (2003) reported that under simulated retail display, consumers chose the lightest chops (L* = 57%) 20.8% of the time, intermediate color chops (L* = 50.2) 26.4% of the time, and dark chops (L* = 45.2) 52.8% of the time. Consumers reported differences in 'liking of juiciness' and 'liking of tenderness' for cooked pork due to color category; however, there were no differences in 'overall acceptability' or 'flavor'.

Consumer Attitudes Towards Fresh Pork Marbling

In 1993, consumer perception of pork appeared to relate to nutritional inferiority particularly in terms of fat, calories and cholesterol (NPPC/MARC, 1993). Levy and Hanna (1994) contended that amount of visible fat was the strongest visual cue for consumers considering pork in retail display (66% said pork has "too much marbling"), reinforcing perception of pork being "bad for you". Even so, 74% of consumers in that study were "very satisfied" or "somewhat satisfied" with pork as a "good value for the money". In a 2001 consumer study, Brewer et al. reported that, based on visual evaluation, consumer stated purchase intent was greater for lean and medium marbled chops than for highly marbled chops, supporting actual selections these consumers made. Forty percent of consumers chose lean chops (<1% fat) for the in-home evaluation portion of this study, 42% chose medium marbled chops (2-2.5% fat), and 18% chose highly marbled chops (3-3.5% fat). Overall appearance acceptability was best for lean and poorest for highly marbled chops, which is consistent with the strong, positive relationship between visual acceptability and purchase intent. In subsequent blind taste tests, the same consumers indicated that the lean chops were the least juicy and flavorful, while highly marbled chops were the most juicy and flavorful. Recently, Rincker et al. (2008) found that when consumers were presented with pork chops with a range in intramuscular fat contents (1.6, 2.5, 3.6, 4.5, and 5.7%), most consumers visually chose chops with <2% extractable lipid. Consumers found that only the chops in the lowest marbling category differed significantly in tenderness, juiciness, flavor and oiliness (Table 2; Rincker et al., 2008). Based on trained panel results, percent extractable lipid was not strongly correlated with tenderness, juiciness, or pork flavor.

Table1. Visual "appearance acceptability" means for pork loin chops of varying colors in various purchase intent categories (Brewer and McKeith, 1999).

Pork Color	Wouldn't buy	Probably wouldn't buy	Might buy	Probably would buy	Would buy
Light pink[1]	**1.6[4]**	**2.3**	**2.9**	**3.4**	**4.1**
Medium pink[2]	2.6	2.8	3.1	3.7	4.0
Dark pink[3]	2.2	2.6	3.1	3.8	4.2

[1] L* = 57.0
[2] L* = 51.5
[3] L* = 38.0
[4] 1 = very unacceptable appearance, 5 = very acceptable appearance

Table 2. —Consumer sensory evaluation of pork loins with different amounts of marbling (Rincker et al. 2008).

	Marbling category[1]					
Trait	*1.5*	*2.5*	*3.5*	*4.5*	*5.5*	*SEM*
Tenderness[2]	3.08 [a]	3.57 [ab]	3.92 [b]	3.85 [b]	3.67 [ab]	0.17
Juiciness[2]	3.19 [a]	3.52 [ab]	3.85 [ab]	4.15 [b]	3.64 [ab]	0.19
Flavor[2]	3.48 [a]	3.43 [ab]	3.45 [a]	3.39 [a]	3.55 [a]	0.10
Oiliness[2]	2.10 [a]	2.30 [ab]	2.47 [ab]	2.69 [b]	2.67 [b]	0.12

[ab]Means within a row with different superscripts differ ($p<0.5$)

[1]Marbling categories: 1.5 = 0.76-1.99% lipid; 2.5 = 2-2.99% lipid; 3.5=3-3.99% lipid, 4.5-4-4.99% lipid; 5.5=5 and above

[2]Sensory scale: 1 = not tender, juicy, flavorful, oily; 5 = very tender, juicy, flavorful, oily

References

Brewer, M.S. 2009. Consumer attitudes: what they say and what they do. An Update. National Pork Producers Council, Des Moines, IA.

Brewer, M.S., Jensen, J., Prestat, C., Zhu, L.G. and McKeith, F.K. 2002a. Visual acceptability and consumer purchase intent of pumped pork loin roasts. J. Muscle Foods. 13(1):53-68.

Brewer, M.S., Zhu, L.G. and McKeith, F.K. 2001. Marbling effects on quality characteristics of pork loin chops: consumer purchase intent, visual and sensory characteristics. Meat. Sci. 59(2):153-163.

Brewer, M.S. and McKeith, F.K. 1999. Consumer-rated quality characteristics as related to purchase intent of fresh pork. J. Food Sci. 64(1):171-174.

Glitsch, K. 2000. Consumer perceptions of fresh meat quality: cross-national comparison. British Food Journal. 102(3): 177-194.

Hunter, R.S. 1986. Objective methods for food appearance assessment. In "Objective Methods in Food Quality Assessment," Kapsalis, J.G. (ed.). CRC Press, Inc., Boca Raton, FL.

Levy, S. and Hanna, M. 1994. Consumer Quality Audit Summary. National Pork Producers Council. Des Moines, IA.

Meisinger, D. J. 2001. Managing the eating quality of pork - realizing benefits along the value chain. In Manipulating pig production VIII. Proceedings of the Eighth Biennial Conference of the Australasia and Pig Science Association. Ed. Cranwell, P.D. Adelaide, Australia. November 25-28. pp.107-115.

National Pork Producers Council. 1993. NPPC/MARC: Meat attitude perception tracker. National Pork Producers Council. Des Moines, Iowa.

Ngapo, T. M., Fortin, J., Aalhus, J. L., and Martin, J. F. 2010a. Consumer choices of pork chops: results from two Canadian sites. Food Research International. 43(6):1559-1565.

Ngapo, T. M., Fortin, J., and Martin, J. F. 2010b. Do pig farmers preferences bias consumer choice for pork? Response to critique of the pork preference studies. Meat Science. 85(4):788-791.

Nielsen. 2009. U.S. consumer trends: Looking back at 2008, ahead to 2009. Jan. 1. The Nielsen Company, New York, N.Y. @

www.nielsen.com.

Norman, J.L., Berg, E.P., Heymann, H., and Lorenzen, C.L. 2003. Pork loin color relative to sensory and instrumental tenderness and consumer acceptance. Meat Science. 65(2): 927-933.

Rincker, P.J., Killefer, J., Ellis, M., Brewer, M.S., and McKeith, F.K. 2008. Intramuscular fat content has little influence on the eating quality of fresh pork loin chops as determined by both trained and consumer sensory panels. J. An. Sci. 86(3), 730-737.

Wachholz, D., Kauffman, R.G., Henderson, D., and Lochner, J.V. 1978. Consumer discrimination of pork color at the market place. Journal of Food Science. 43(4): 1150-1152.