Packaging Influences Beef Quality Attributes

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Many factors influence the shelf-life, color, and sensory attributes of beef. Packaging is one of those factors. There are several different types of packaging used in the meat industry, including vacuum packaging, overwrap, and modified atmosphere packaging (MAP). Traditionally wholesale cuts are vacuum packaged, boxed, and sent to retailers where they cut the meat, place it on a styrofoam tray, and overwrap it with a clear plastic film that allows oxygen to pass through the film and bloom the meat (it turns red). Vacuum packaging is typically not used in retail fresh meat because the meat is purplish-red in color, and many consumers find that color unattractive. Newer technology, such as MAP, is done at a centralized packaging facility. This consists of fabricating the meat, placing it in a rigid plastic tray, flushing the atmospheric air out of the packaging and replacing it with gas(es) of known concentration, and sealing it with clear plastic film that does not allow air to pass through it. Prior to packaging meat in MAP, whole muscles are often injected with an enhancement solution consisting of water or beef broth, salt, phosphate, and natural flavorings. Meat packaged in MAP has an extended shelf life compared to meat packaged in overwrap. There are different types of MAP that depend on the concentration of gases used. High-oxygen (HiO2) MAP usually consists of 80% O2 and 20% CO2. Ultra-low-oxygen with carbon monoxide (ULO2CO) MAP usually consists of 60-70% N2, 20-40% CO2, and 0.4% CO.

Research comparing beef steaks packaged in vacuum packaging, HiO2 MAP, and ULO2CO MAP resulted in several differences (Grobbel et al., 2007). Steaks packaged in HiO2 MAP had less color stability than all other packaging treatments evaluated because steaks discolored faster and to a greater extent. Ultra-low oxygen CO MAP and vacuum packaging treatments had better fresh color stability than steaks packaged in HiO2 MAP and had equal or better tenderness. Packaging atmospheres altered internal cooked color, with steaks packaged in HiO2 MAP exhibiting premature browning. Premature browning occurs when meat turns brown and appears well done but is actually at a temperature lower than what is considered safe for consumption. Strip loin steaks packaged in the HiO2 MAP system were less tender at the end of display than other packaging treatments, which may have been because of the shorter aging time associated with the HiO2 MAP system. Packaging beef in ULO2CO MAP provides beef with a desirable bright red color with extended color stability and provides for a longer aging

time and increased tenderness while resulting in an internal cooked color that is expected (pinkish red) when cooked to a medium degree of doneness.

In a separate project, steaks were injection-enhanced or non-enhanced prior to packaging (Grobbel et al., 2007). More off-flavors were associated with enhanced steaks than non-enhanced steaks. Enhanced steaks were juicier, had less perceptible connective tissue, and darker in fresh color than non-enhanced steaks. Steaks packaged in HiO2 MAP were less tender according to sensory panelists and had more off-flavors than those packaged in either ULO2CO MAP or vacuum packaging. There were no differences in instrumental tenderness of steaks in different packaging after 14 days of aging. Different packaging types and injection-enhancement can alter the color, shelf-life, tenderness, and flavor of beef (Table 1).

Table 1. Summary of quality traits from beef steaks packaged in different systems or non-enhanced vs. enhanced

	Vacuum Package	HiO_2 MAP	ULO_2CO MAP	Non-enhanced	Enhanced
Color of meat	Purplish-red	Red	Red	Red	Slightly darker
Color at end of display	Purplish-red	Brownish-red	Red	Depends on packaging type	
Internal cooked color*	Pinkish-red	Brown	Pinkish-red		
Tenderness	More	Less	More	Less	More
Off-flavor(s)	No	Yes	No	No	Yes

*Steaks were cooked to a medium degree of doneness (158°F)