Meat Science 81 (2009) 589–595

Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Effect of grape seed extract on descriptive sensory analysis of ground chicken during refrigerated storage

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ARTICLE INFO

Article history:
Received 18 June 2008
Received in revised form 10 October 2008
Accepted 14 October 2008

Keywords:
Grape seed extract
Descriptive sensory analysis
Color
Yield
pH
Binding strength

ABSTRACT

Descriptive sensory analysis, instrumental color, yield, pH, water activity, and binding strength were determined on ground chicken breast and thigh with or without grape seed extract (GSE) during refrigerated storage. In chicken breast, GSE inhibited the intensity of musty and rancid odor, and rancid flavor compared to control patties, but GSE caused significantly darker (L^*), redder (a^*), and less yellow (b^*) patties. No differences were observed for pH, water activity, or yield, though differences were observed for binding strength. In chicken thigh, sensory scores were significantly different for 14 of 15 sensory attributes, although the differences were due to storage time or precooking, not the presence of GSE. GSE caused significantly darker sensory scores and L^* values, and redder (a^*) and less yellow (b^*) patties. Differences in binding strength and yield were attributable to precooking, not the presence of GSE. GSE may be an effective antioxidant in precooked chicken breast systems.

1. Introduction

There is increasing evidence demonstrating the ability of grape seed extract (GSE) to retard lipid oxidation in meat during storage, most likely due to the fact that GSE is a rich source of polyphenolic compounds, especially proanthocyanidins (Weber et al., 2007). In raw meat, GSE has been shown to be effective in reducing the amount of primary lipid oxidation products (e.g. lipid hydroperoxides and hexanal) and secondary lipid oxidation products (e.g. thiobarbituric acid reactive substances, a.k.a. TBARS) in beef (Banon, Diaz, Rodriguez, Garrido, & Price, 2007), chicken (Lau & King, 2003), fish (Pazos, Gallardo, Torres, & Medina, 2005), and pork (Carpenter, O'Grady, O'Callaghan, O'Brien, & Kerry, 2007). In cooked meat, GSE also has been shown to be effective in reducing the amount of primary and secondary lipid oxidation biomarkers in ground beef (Ahn, Grun, & Fernando, 2002; Ahn, Grun, & Mustapha, 2007; Rojas & Brewer, 2007), turkey breast (Mielnik, Olsen, Vogt, Adeline, & Skrede, 2006), chicken breast (Rababah et al., 2006), and pork (Carpenter, O'Grady, O'Callaghan, O'Brien, & Kerry, 2007; Rojas & Brewer, 2007).

However, polyphenolic-rich GSE has a very red color and is known to be astringent (Monteleone, Condelli, Dinnella, & Bertuccioli, 2004) which may affect the sensory characteristics of products to which it is incorporated. GSE reduced the development of rancid meat flavor but did not affect meat color during 6 d of refrigerated storage of raw beef (Banon et al., 2007). GSE also reduced warmed over flavor in cooked beef during 3 d of refrigerated storage (Ahn et al., 2002) and rancid and wet-cardboard off-odor scores without affecting color during 8 d of refrigerated storage (Rojas & Brewer, 2007). In raw and cooked pork that was stored refrigerated, addition of GSE did not affect sensory scores or color (Carpenter, O'Grady, O'Callaghan, O'Brien, & Kerry, 2007; Rojas & Brewer, 2007). Addition of GSE did not cause any initial changes in flavor scores in irradiated and non-irradiated whole chicken breasts (Rababah, Hettiarachchy, Eswaranandam, Meullenet, & Davis, 2005).

The current study was built upon previous work that demonstrated that 0.1% GSE completely inhibited the formation of lipid hydroperoxides and thiobarbituric acid reactive substances (TBARS) in cooked beef, pork, chicken breast, and thigh after 7 d of refrigerated storage (Brannan & Mah, 2007). This work also showed that GSE is an effective antioxidant in cooked chicken breast and thigh during frozen storage. Subsequently, ground chicken thigh meat with and without the addition of GSE and NaCl was held under refrigerated storage at 59%, 76%, 88%, and 99% relative humidity. GSE was shown to be an effective antioxidant in ground chicken thigh meat that did not affect moisture content or pH during storage, inhibited TBARS formation, helped to mitigate the pro-oxidative effects of NaCl, and altered the effect of NaCl on protein solubility in salted chicken patties (Brannan, 2008). What is not known is how these physicochemical interactions of GSE affect raw and cooked meat quality attributes. The objective of the current study was to quantify the sensory odor, taste, flavor,

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doi:10.1016/j.meatsci.2008.10.014

and color changes that occur in raw and precooked ground chicken breast and thigh with and without GSE during 12 d of refrigerated storage. Instrumental color, binding strength, yield, water activity, and pH were also determined.

2. Materials and methods

2.1. Raw materials, sample preparation, and storage conditions

GSE (Gravinol-S®) was obtained from a commercial source (Kikkoman International, San Francisco, CA). Through an arrangement with a local retailer, boneless chicken thighs were obtained on the morning that they arrived at the store. Boneless chicken breasts were obtained from the same retailer. Food used as sensory standards and references were obtained from retail markets. All other chemicals and solvents were obtained from Fisher Scientific (Waltham, MA).

Skinless chicken breast or thigh meat was cut by hand into strips and then ground once through a stand mixer using a food grinder attachment with a coarse grinding plate (model K45SS/250W, KitchenAid®, Whirpool Corporation, MI). An aqueous stock solution of GSE and/or water were incorporated into the ground meat to standardize the systems to final reaction concentrations of 0.1% GSE (w/w) by mixing by hand for 1 min. Control patties contained no GSE. Ground meat (20 g) was formed into disc-shaped patties, placed in FoodSaver® bags with no attempt made to exclude oxygen from the bags, then heat sealed. Some were immediately stored refrigerated (4 °C) while others were cooked before storage. The cooking procedure involved placing a single layer of the square bags in boiling water for 3 min, then turning the bags over and cooking for an additional 3 min to achieve an internal temperature of at least 77 °C. The temperature was monitored using an eight-channel thermocouple (Omega Industries, Grafton, WI). The bags were cooled on ice then stored refrigerated (4 °C). After 0, 4, 8, or 12 days of refrigerated storage, the bags were moved to a freezer (−18 °C) for up to 14 days before sensory analysis was performed.

2.2. Descriptive sensory analysis

A descriptive panel with six members underwent more than 20 h of general training of which the final 3–4 h was used to determine the consensus list of odors, basic tastes, and flavors and the references for each descriptor. The list of descriptors, definitions, and references are shown in Table 1. The descriptor for "rancid odor" was added at the suggestion of the panel after analyzing the first replication of the chicken thigh patties. A 15-point line scale anchored only by the references and the warm-up sample was used in assigning values to the various descriptors. During training and sampling, panelists had access to unlimited water and unsalted saltines. Twelve sampling days of 5 or 6 samples per sampling day were required. On each day of sampling, panelists spent a few minutes familiarizing themselves with the anchored references and then were presented a warm-up sample consisting of cooked chicken that was used for calibration. Completely thawed patties for sampling in the bags in which they were stored were coded with random three digit numbers. Patties that were stored raw were cooked and patties that were stored cooked were reheated using a water bath then held under infrared lamps for not more than 15 min before being presented to the panelists. Panelists were instructed to cut open a corner of the bag and immediately sniff the released steaming vapor to rate the odor descriptors. Panelists then tasted the sample and rated the basic tastes and flavors.

2.3. Measurement of water activity, pH, binding strength, color, and yield

Crude water activity (a_w) of the chicken thigh meat (3 g) was measured using a PawKit water activity meter (Decagon Devices Inc., Pullman, WA) with an accuracy of ±0.02a_w units. A pH meter (Accumet AB15 Plus, Fisher Scientific, Waltham, MA) calibrated daily to pH 4 and 7 was used to monitor the pH of a 20 g sample of cooked chicken meat by plunging the pH meter electrode into direct contact with the chicken meat. Binding strength was measured as the grams of force required to dislodge a 1.27 cm cylindrical plug from the patty using a Ta-XT2i Texture Analyzer (Texture Technologies Corp., Scarsdale NY/Stable Micro Systems, Godalming, Surrey, UK). The meat patty rested on a flat platform with a 1.27 cm circular whole through which a 1.27 cm cylindrical probe traveling at a crosshead speed of 1 mm/s would pass. The probe was deployed at a distance sufficient to completely dislodge the plug from the patty. The texture analyzer was controlled via Texture Expert Software and this package was used to record data and generate force-determination curves. CIE L^*, a^*, and b^* values for color were measured using a Konica BC-10 (Konica Minolta Sensing Americas Inc., Ramsey, NJ) colorimeter. The measurements were made on patties after they were heated for sensory analysis and were taken through the clear packaging film with enough pressure applied such that there was no space between the color-

Table 1
Attributes, standard references, and ratings used in descriptive sensory analysis of raw and cooked ground chicken.

	Attribute	Definition	Reference	Rating
Odors	Chicken brothy	Aromatics associated with chicken broth	Swanson® Natural Goodness™ chicken broth	12
	Fishy	Aromatics associated with cooked fish	Freshly cooked talapia	10
	Sulfury	Aromatics associated with boiled egg yolk	Boiled egg yolk	5
	Musty	Aromatics associated with wet cardboard	Wet cardboard	4
	Rancid	Aromatics associated with oxidized oil	Oxidized flax seed oil	None
Tastes	Sweet	Taste associated with sucrose solutions	5% sucrose	5
	Sour	Taste associated with citric acid solutions	0.08% citric acid	5
	Salty	Taste associated with sodium chloride solutions	0.5% sodium chloride	5
	Bitter	Taste associated with caffeine solutions	0.05% caffeine	5
	Umami	Taste associated with monosodium glutamate solutions	0.1% monosodium glutamate	7.5
Flavors	Metallic/serumy	Flavor associated with blood or rare meat	Rare beef (top sirloin)	3
	Cooked chicken	Flavor associated with cooked chicken breast tenderloins	Boiled chicken breast tenderloin	9
	Fatty	Flavor associated with rendered chicken fat	Rendered chicken skin	8
	Fishy	Flavor associated with cooked white fish	Freshly cooked tilapia	11
	Rancid	Flavor associated with rancid/oxidized oil	Oxidized flax seed oil	6
Appearance	Surface color	Color of the outer surface of the sample	Boiled chicken tenderloin	1
			Rare beef (top sirloin)	14