Pomegranate Rind Extract Limits Ground Beef Color Discoloration and Lipid Oxidation

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ABSTRACT

Meat color is extremely influential in purchasing decisions as consumers associate color with freshness. Discoloration of beef at retail has resulted in a loss of about $1 billion annually. Many additives, including antioxidants, have been utilized in products such as ground beef to increase their shelf life. Therefore, the overall goal of this study was to evaluate the effects of pomegranate rind extract on ground beef color stability and oxidation. Pomegranate rind was evaluated as an antioxidant to improve meat color and prevent discoloration in ground beef patties caused by oxidation. Pomegranate rind extract was added to 100 g patties. Patties were then assigned four different modified atmosphere packaging types: polyvinylchloride (PVC; n = 36), high oxidation (Hi-Ox; n = 36), carbon monoxide (CO; n = 36), and vacuum (n = 36). A trained color panel scored display color and surface discoloration for each ground beef patty every day that specific packaging type was on display, 3 d for PVC, CO and vacuum and 5 d for Hi-Ox. Oxidation was also measured on the control patties on d 0 and on all samples at the end of the display period. The trends showed that the samples with pomegranate solution added had a brighter cherry-red color. There was also a reduction in oxidation in the patties with the pomegranate solution, 50% less for vacuum and PVC, 65% less for CO and 75% less for Hi-Ox. These results conclude that using pomegranate rind will reduce discoloration and oxidation in ground beef patties.

KEYWORDS: Antioxidant, Ground Beef, Oxidation, Pomegranate

INTRODUCTION

Ground beef is the highest consumed form of beef in the United States totaling 57% between food service and retail (Close, 2014). Ground beef is so popular because it is cheaper when compared to other beef cuts and more convenient to prepare while still being a viable

source of protein. Due to its popularity, ground beef is a common item found in grocery stores. However, like other fresh meats, ground beef has a limited shelf-life due to its exposure to oxygen which is required for a cherry-red color.

In the grocery store, meat color is examined by the consumer before purchasing and affects how they ultimately decide on a product's quality. Studies have shown that meat color and packaging type affect consumers' purchasing decisions (Carpenter et al., 2000). This reinforces the importance of maintaining a high quality product from processing to packaging and finally during display. Beef color can naturally occur as red, purple, or brown. The color is determined by changes in myoglobin which contains iron and a binding site for different biochemical components to connect to (Brooks, 2007). Consumers prefer bright cherry-red colored meat over dark or discoloring meat due to the association of the color red to higher quality (Schevey et al., 2013). Therefore, it is imperative to avoid any discoloration to meat before or while it is displayed for purchase.

One main factor that can cause discoloration in meat is oxidation. Oxidation first begins when beef is exposed to oxygen. This occurs when oxymyoglobin, the meat pigment that gives beef its bright cherry-red color, is deteriorated to metmyoglobin, a brown pigment (Boles and Pegg, 2005). Oxidation is subject to the chemical structure of the meat, the existence of light and oxygen and storage temperature (Králová, 2015). It not only affects the meat color and shelf-life of ground beef but also results in a rancid off-flavor and off-odor (Jakobsen and Bertelsen, 1998). Since oxidation has a great impact on the deterioration of quality in ground beef causing a negative economic impact, there is a need for a solution.

Fortunately, oxidative affects are decreased through the use of antioxidants (Morsy et al., 2017). The antioxidant chosen in this study to combat oxidation was pomegranate, specifically

the use of the rind to make an extract. The rind of a pomegranate includes a high amount tannins, anthocyanins and flavonoids which are all phenolic compounds that have a positive impact on health (Mousavinejad et al., 2009). The goal of this study was to evaluate the use of the pomegranate rind extract as an antioxidant in ground beef.

MATERIALS AND METHODS

Pomegranate rind extract:

The pomegranate rind extract was prepared by mixing dried ground rind powder in boiling water. The mixture was centrifuged (Awel Centrifugation C 48-R; Blain, France) at 15,000 g for 5 min to extract the pomegranate rind solution.

Preparation of meat samples:

Course ground beef (80% lean) collected from chuck trim was mixed by hand with 0, 1, and 1.5% of pomegranate rind extract. The pomegranate rind extract was included into the sample, fine ground and then formed into a 100 g patty, utilizing the adjust-a-burger patty press.

Ground beef packaging:

Patties from each treatment were then assigned to four different packaging types: PVC (n = 36), Hi-Ox (n = 36), CO (n = 36), and vacuum (n = 36). Patties packaged in CO and vacuum bags were stored in dark storage 5 d prior to display. The vacuum patties were removed from the bags, packaged in PVC and allowed 1 h to bloom prior to evaluation. Patties packaged in PVC, CO and vacuum were on display for 3 d while patties packaged in Hi-Ox were left on display for 5 d.

Panel and testing:

Patties were evaluated each day by trained color panelists (6 members). Patties were evaluated for display color and surface discoloration. Display color was scored on a range of 1 to

8: 1 represented very bright red, 2 represented bright red, 3 represented dull red, 4 represented slightly dark red, 5 represented moderately dark red, 6 represented dark red or tannish-red, 7 represented dark reddish-tan, and 8 represented tan or brown. Surface discoloration was scored on a range of 1 to 7: 1 represented no discoloration (0%), 2 represented minimal discoloration (1-10%), 3 represented slight discoloration (11-20%), 4 represented small discoloration (21-40%), 5 modest represented discoloration (41-60%), 6 represented moderate discoloration (61-80%), 7 represented extensive discoloration (81-100%).

Thiobarbituric acid-reacting substances (TBARS) measurement:

Oxidation was measured on the control patties on d 0 and then evaluated on all treatments at the end of their assigned display time. Three g of the sample was blended with 27 mL of trichoracetic acid (TCA) in a homogenizer for 10 sec. The sample was then filtered using 125 mm filter paper. One mL of the filtered sample was then mixed with 1 mL of thiobarbitunic acid (TBA) in a glass test tube. The sample was then placed in a 100°C water bath for 10 min and allowed to cool for 5 min before measuring for TBARS using a cuvette.

Statistical Analysis:

The experiments were replicated six times (n = 6). The data was analyzed using the Mixed Procedure of SAS, and trends were evaluated.

RESULTS AND DISCUSSION

The trends showed that display color was brighter cherry-red for samples with pomegranate solution compared to the control samples. Similarly, surface discoloration decreased for patties with the addition of pomegranate solution compared to the controls. Patties packaged in Hi-Ox maintained color stability longer than patties packaged in PVC, CO, and vacuum. There were also decreases in the oxidation levels of the patties enhanced with 1.0 and

1.5% pomegranate solution compared to the control patties, for all packaging types. Samples enhanced with 1.5% pomegranate solution in vacuum and PVC packaging had 50% less oxidation after display than the control. Similarly, samples with 1.5% pomegranate solution packaged in CO had 65% and Hi-Ox had 75% less oxidation compared to the controls.

These results show that using pomegranate as an antioxidant is an effective way to not only maintain a bright cherry-red color but also decrease oxidation. Similar findings have been concluded in other studies using pomegranate by-products in meat. In Ibrahim et al. (2012), using pomegranate rind extract resulted in the highest oxidation inhibition ($P < 0.05$) in beef patties when compared to pomegranate seed and pomegranate juice. Dua et al. (2016) also found similar findings, the pomegranate rind extract significantly decreased ($P < 0.05$) the effect of oxidation which was measured through the use of thiobarbituric acid-reacting substances (TBARS) values. In El-Nashi et al. (2015), pomegranate peel powder was used in beef sausage and showed significant increase ($P < 0.05$) in the sensory characteristics of the cooked sausage. Appearance, color, tenderness, flavor and overall liking were included in sensory characteristics. All of these studies show that pomegranate is a successful tool to inhibit oxidation.

CONCLUSION

The deterioration of meat quality due to oxidation is a huge issue facing the meat industry today. Consumers are aware of the quality they are purchasing in the grocery store and when that quality is lower than expected, the purchase is unlikely. This led to the use of pomegranate rind extract as an antioxidant in this study to maintain meat color and reduce oxidation, increasing retail display. The use of pomegranate in ground beef patties had major positive impacts on both color stability and overall freshness. The pomegranate rind extract also efficiently combatted oxidation in the ground beef and improved shelf life. This proves that the use of pomegranate as

an antioxidant can be an effective way to fight one of the largest economic issues in the meat industry. Hopefully, through the use of antioxidants in meat, the economic loss that results from discoloration and oxidation can be decreased.

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