2016 Reciprocal Meat Conference – Meat and Poultry Processing, Ingredient Technology and Packaging

Meat and Muscle Biology™

Lentil-Based Ingredients Can Delay Myoglobin and Lipid Oxidation of Frozen Beef Burgers

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Keywords: beef burger, colour, lentil, lipid oxidation, myoglobin
Meat and Muscle Biology 1(2):32 **doi:10.221751/rmc2016.031**

Objectives

Color is a critical property of raw meat products since myoglobin tends to oxidize over time and contributes to color changes under frozen conditions. Lipid oxidation may also take place during frozen storage leading to the off-flavor. The objective of this study was to evaluate the effect of incorporating lentil flour into beef burgers on the surface color, composition of myoglobin species and lipid oxidation during frozen storage.

Materials and Methods

Beef top and bottom rounds were used. Lentil seed with or without heat treatment were the binder source. Heat treatment was conducted by infrared heating of moisture adjusted lentil seed. The flours of whole seed, cotyledon and seed coat were added to burgers (17% fat) at the levels of 6.0, 5.4, and 0.6%, respectively. Other ingredients include salt (0.9%) and water (8.1 to 14.1%). Two control burger groups with water levels of 8.1 and 14.1% and reference samples with sodium erythorbate (0.05%) and toasted wheat crumb (6.0%) were also made. Burgers were then stored in the dark at –20°C. Moisture, protein, fat, and ash content of burgers were determined. Color (L^*, a^* and b^*) and percent deoxy-, oxy- and met- myoglobin on the surface of the frozen burgers and thiobarbituric acid reactive substances (TBARS) were determined at various times during frozen storage. A full factorial design ($2 \times 3 \times 5$) was used and the factors were: treatment (heated or not), seed component (whole seed, cotyledon or seed coat), storage time (0, 3, 6, 9, and 12 wk) and their interactions. Three replications were conducted. Analysis of variance was applied using the GLM procedure of the SAS 9.4 (SAS Inst. Inc. Cary, NC) at the level of significance of 0.05.

Results

Beef burgers incorporated with each type of lentil flour exhibited significantly higher a^* values and higher oxymyoglobin percentage ($P < 0.05$ and $P < 0.05$, respectively) compared with the control burgers. No statistical difference was found between burgers with heat treated and untreated lentil flours. But higher a^* value and higher oxymyoglobin were found in the burgers incorporated with cotyledon than the burgers with seed coat ($P < 0.05$ and $P < 0.05$). The addition of sodium erythorbate at 0.05% in the burger formulation caused a dark purple surface color of the frozen burgers due to a high percentage of deoxymyoglobin. The burgers incorporated with toasted wheat crumb at 6% showed lower a^* value compared with the burgers with each type of the lentil flour.

The TBARS values for burgers with each lentil flour treatment were at least 33% lower than that of the control groups. The TBARS values of burgers with heat treated lentil flours were lower than the burgers with untreated ones ($P < 0.05$), likely due to the lower activity of oxidative enzymes such as lipoxygenase in the heat treated lentil flours. No difference was found on the TBARS values between the burgers contained flours of cotyledon and seed coat ($P > 0.05$), probably due to their similar content of water soluble phenolics.

Conclusion

The results indicated that incorporating heat treated lentil flour performed the best in prolonging the redness of frozen beef burgers and in retarding lipid oxidation during frozen storage. Together with its textural benefits to beef burgers, more bland flavor and low content of oxidative enzymes observed from previous studies, heat treated lentil flour is a multi-functional meat binder that can extend storage life of frozen beef burgers.

