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QUALITY ATTRIBUTES OF LOW-FAT CHERRY GROUND BEEF PATTIES

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Background

Consumers are more conscious about the fat content in foods. The need for fat reduction in our diets has been articulated in the recommendations of the American Cancer Society and American Heart Association. A low-fat beef pattie which contains a significant amount of red tart cherry tissue (13%) in the meat block has been developed. Preliminary data indicate this lean ground beef mixture, Plevalean™, is superior to lean (10% fat) ground beef in many consumer attributes (Ray Pleva, personal communication).

Objectives

The objective of this study is to compare Plevalean™ to commercial ground beef containing 10%, 20%, 28% fat, to carrageenan-containing and isolated soy protein-containing low fat ground beef in organoleptic contributes, shelf stability, and objective measures.

Methods

Sample preparation

Coarse ground 10% (10G), 20% (20G), 28% (28G) fat beef were purchased from a commercial meat company. PlevaLean™ (PL), iota carrageenan-containing (CA) and isolated soy protein-containing (SP) low-fat ground beef were prepared using the same lots of meat. The PL contained 10G, red tart cherries, seasonings and oat fiber. The CA contained 10G, water, carrageenan, encapsulated salt and hydrolyzed vegetable protein. The SP contained 10G, isolated soy protein, water, encapsulated salt and hydrolyzed vegetable protein.

Coarse ground beef was mixed with the designated ingredients for 1 min. For PL products, the cherries were flaked first. For the 10G, 20G and 28G patties, no ingredients were added during the 1 min mixing. The mixtures were reground through a 3.2 mm plate. Six ounce patties (16 mm thick) were formed using a hamburger press. They were divided and assigned to long time frozen storage (-20°C) and short time refrigerated storage (4°C) studies. All patties were cooked to an internal temperature of 69°C before sample evaluation. To establish the contribution of individual non-meat ingredients or water/methanol soluble extracts of the cherry to shelf stability traits, the same proportion of the ingredient in PL was added to 10G. Patties were formed and cooked as described above.

Composition, pH, cooking yield, and caloric content

Moisture, fat, and protein contents were determined (AOAC, 1990). The initial pH of each treatment repliction was measured. Cooking yield was determined by dividing the cooked weight by the raw weight and multiplying by 100%. Caloric content of the raw patties was calculated based upon their composition using factors for calculating energy values (Merrill and Watt, 1973).

Shear force and tensile strength

Shear force was determined using Texture Test Systems model T-2100 equipped with a standard shear-compression cell. Tensile strength was measured using the same texture test systems equipped with a thin slice tensile test cell model ST.

Measurement of lipid oxidation

Lipid oxidation was evaluated by the Thiobarbituric acid method (Crackel et al., 1988). Samples were evaluated after 0, 3 and 6 days at 4°C, after 3 and 6 months at -20°C and for the refrigerated cooked samples after cooking (0 day) and after 1 day of storage.

Sensory evaluation

Cooked patties were evaluated by 10-member trained sensory panel (AMSA, 1978). Samples were cooked 10 min before evaluation and held warm (50°C) in chafing dishes. Sensory evaluation was completed within 40 min of cooking. At each setting, panelists rated samples for juiciness, tenderness, flavor intensity and overall acceptability using an 9-point scale. Each treatment was evaluated for each of three replicates

Results and Discussion

Proximate composition and physical measures of ground beef patties

Low-fat patties contained less fat ($P<0.05$) and more moisture ($P<0.05$) than the all-beef patties containing 23% and 28% fat. PL patties had the lowest pH ($P<0.05$). This may be due to the incorporation of the cherries (pH = 4.0). The SP and PL patties which contained oat bran had higher cooking yield than 10G. This is consistent with previous claims regarding oat-bran in ground beef patties (McMindes, 1991).

Shear force values indicated that the PL, CA and SP patties were the most tender products evaluated and significantly more tender ($P<0.05$) than 10G patties. The latter had significantly higher ($P<0.05$) shear force values. This is consistent with previous published information for ground beef of similar fat content (Egbert et al., 1991). There were no significant differences among treatments for tensile strength. This agrees with Egbert et al., (1992). The texture for all treatments appeared to be similar. Mealiness was not evaluated.

There were no differences in the total calories among low-fat treatments with 10G comprising 160 Kcal/100 g and PL, CA and SP containing 150 Kcal/100 g. Patties containing 28% fat had higher total calories than patties containing 20% fat (310 and 250 Kcal/ 100 g, respectively).

Pattie stability

The extent of lipid oxidation increased during refrigerated storage (0.3 to 2 mg malonaldehyde/kg meat), except for PL patties which remained relatively unchanged (0.4 mg malonaldehyde/kg meat). The TBARS values at day 0 samples were extremely variable. This may be due to the long time from processing to day 0 (24 h). Patties containing higher fat (20G and 28G) had higher TBARS values than patties containing lower fat (10G, PL, CA and SP) at day 0. On day 3 most of the treatments had TBARS values greater than 1. On day 3, PL patties had the lowest TBARS values when compared to the other treatments ($P<0.05$). The difference between these treatments was more evident on day 6. Treatments containing iota carrageenan underwent greater lipid oxidation than all-beef patties (Egbert et al.,1992). In this study, CA low-fat treatments had the highest TBARS number (2.0 mg malonaldehyde/kg meat) of the products tested.

The treatment effects during frozen storage were similar to those measured during refrigerated storage. Higher fat patties had significantly ($P<0.05$) greater lipid oxidation. PL patties had the lowest lipid oxidation as measured by TBARS values among these treatments.

All treatments were further investigated for oxidative stability after cooking. The CA and SP patties had significantly higher lipid oxidation than PL after 24 h storage. Lipid oxidation in PL patties was significantly ($P<0.05$) lower than the 10G and remained unchanged after one day.

Sensory properties

The PL, CA and SP treatments all had higher flavor intensity than 10G patties. The data for CA and SP agree with the results of previous research (Egbert et al.,1991;1992). PL and CA patties also had the highest ($P<0.05$) tenderness values when compared to the other treatments. The sensory scores for tenderness agree with shear force values. However, they were not consistent for SP patties.

Panelists rated 20G and 28G higher for juiciness. The low-fat all beef patties (10G) were evaluated as being the least juicy. PL and CA patties were more juicy than 10G. It was reported in a similar carageenan-containing beef product that juiciness is improved through the retention of moisture within the product (Egbert et al., 1991). In this experiment, retention of moisture within the product improved juiciness in PL and CA patties but could not completely replace the functional properties of fat in juiciness. Juiciness values for PL remained constant while CA and SP treatments had lower ($P<0.05$) juiciness values after 3 days of refrigerated storage.

Panelist responses for overall acceptability were variable and generally not significant. Some panelists disliked the spice mixture in the ground beef patties (PL, CA and SP), while others liked it. This may explain the diverse response for overall acceptability. The sensory panel was trained with all-beef products, The trends after frozen storage are similar to those after refrigerated storage.

The sensory panel also rated the treatments for warmed-over flavor (WOF) one day after cooking. PL had the lowest ($P<0.05$) WOF value (2.9) when compared to the other treatments (3.6-5.1). Other traits measured by the panel followed similar trends as reported above. This observation agrees with TBARS data after cooking as well as TBARS values after raw refrigerated and frozen storage.

To further demonstrate which ingredients contributed to the antioxidant effect in PL patties, ingredients were individually studied in cooked ground beef. The red tart cherries at a concentration used in PL had the most dramatic response when TBARS values were evaluated. Compounds with antioxidant activity have been found in a variety of plant foods such as oats, soybeans and spices (Wu and Brewer, 1994). Polyphenols and colorless flavonoids including anthocyanins are frequently found in the vacuoles of higher plants such as cherry (Brouillard et al.,1989). Preliminary data extracting the cherry tissue with water and methanol suggest that both anthocyanins (compounds in total flavonoids) and polyphenols (compounds in total non-flavonoids) in combination may be responsible for the antioxidant effects observed in the red tart cherry when incorporated into ground beef.

CONCLUSIONS

The combination of red tart cherries, oat brans and spices can be used to produce a high quality, low-fat ground beef pattie. It will also improve tenderness as measured by both shear force and a sensory panel, while tensile strength of the ground beef will not be effected. Total calories will be reduced approximately 50%. This combination of ingredients also produces a significant antioxidant effect as measured by TBARS values as well as sensory warmed-over flavor evaluations. It appears as if many of the negative attributes of low-fat all-beef patties may be eliminated through the use of this combination of ingredients. Further research is needed to substantiate these observations focusing on additional methods which will study the antioxidant and functionality contributions.

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