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KONJAC FLOUR/CARRAGEENAN GEL AS A SUITABLE FAT REPLACER IN A GROUND MEAT SYSTEM

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Keywords: Konjac flour, Lowfat, Ground beef, Hydrocolloids

INTRODUCTION

Consuming diets containing high levels of animal fats have been linked to higher risks for colon cancer, cardiovascular diseases and several other disorders (NCI, 1984). As the general population became more concerned about reducing these risks, per capita consumption of animal fats and red meats has declined (USDA, 1984; Anonymous, 1985; McNamara, 1985).

The desire by consumers for reduced fat products has driven meat processors to try and meet the demand by simply removing the fat from ground meat systems. Typically, ground beef contains between 20 and 30% fat. As the fat content is reduced below the 20% level to 10% or less, there have been notable declines in tenderness, flavor, juiciness, satiety and overall acceptability (Huffman and Egbert., 1990; Egbert *et al.*, 1991; Troutt *et al*, 1992).

To compensate for decreases in the favorable characteristics of meat products as the fat level goes down, reduced fat ground meat systems have been extended using non-meat ingredients, such as hydrocolloids. Hydrocolloids function by retaining moisture in the final product, thereby enhancing the texture, tenderness and juiciness. Because of their creaminess, smoothness and lubricating effects, hydrocolloids tend to mimic the organoleptic characteristics found in fat (Glicksman, 1991).

OBJECTIVES

The objectives of this study were to evaluate the initial feasibility and consumer acceptability of incorporating varying levels of a gel made from a konjac flour-carrageenan mixture as a fat replacer in a ground meat system.

MATERIALS & METHODS

Patty Formulation

Ground beef patties were formulated from lean and fat beef trim obtained from frozen U.S. commercial cow trim (95% lean), and U.S. Select and Choice lean and fat trim inventories at the Clark Meat Science Center. Lean and fat meats were ground separately through a 1 cm plate using a Butcher Boy Model-52 meat grinder (Lasear Manufacturing Inc., Los Angeles, CA.). Six random samples of each component were collected, homogenized and ground two times through a 0.32 cm plate. Four two ounce subsamples of each component were analyzed for fat content using a Hobart Ground Beef Fat Analyzer Model F-101 (The Hobart Mfg. Co., Troy, Ohio). Values were averaged for each component and used for further formulation using Pearson square. Lean trim, fat trim and konjac/carrageenan (K/C) gel were blended to formulate batches containing 20%fat/0% K/C (control), 15% fat/5% K/C, 10% fat/10% K/C, and 5% fat/15% K/C. Batches were hand mixed for two minutes, ground through a 0.32 cm plate, and processed into patties (≃ 110 g) using a Hollymatic Super, Model-54 patty machine (Hollymatic Corporation, Park Forest, Illinois).

Gel Manufacture

The K/C gel was formulated containing 985 g water, 10 g of Nutricol K80V konjac flour (FMC Marine Colloids Div., Philadelphia, PA.) and 5g Gelcarin XP 8007 carrageenan(FMC Marine Colloids Div., Philadelphia, PA.). The total gel weight was 1000 g. The water was preheated to 80° C. and placed in a Kitchen Aid (Hobart Inc., Troy, Ohio) stainless steel mixing bowl. The konjac flour and carrageenan were mixed together in dry form and added slowly while mixing at high speed for seven minutes with the wire whip attachment. After mixing, the gel was allowed to hydrate for 12 hours, then 7.5 mls of potassium carbonate were added. The gel was poured into one quart glass jars, sealed and heated under pressure (10 psi) for 15 minutes. After cooling, the gel was ground through a 0.32 cm plate and the appropriate amounts added to each meat block during mixing.

Cooking Yields

Five patties from each treatment were used to determine approximate cooking yields (weight of cooked patty / weight of uncooked patty X 100). Patties were weighed prior to and after cooking as outlined above. Cooked patties were blotted once on each side and allowed to set for one minute before final weight determination.

Consumer Testing

Patties were cooked on an preheated electric griddle (The Westbend Co., Westbend, Wisconsin) at a setting of 178° C for 5 minutes on one side, turned and cooked for another one minute and forty-five seconds on the second side. Final patty temperature (69-71° C) was determined using a hypodermic probe-type thermometer at the geometric center of each patty.

Each patty was divided into four approximately ≃ 20 g samples and served to consumer panelists for evaluation on a 9-point Hedonic scale for acceptability and purchase intent (Meilgaard et al. 1991).

RESULTS

Cooking Yields

There were no significant differences ($p>0.05$) between treatments or between the treated samples and the control in cooked yields. Studies by Berry (1992) and Troutt *et al.* (1992) showed that as fat levels decreased, cooking times increased. This was not the case with the K/C gel substitution. All patties in all treatments achieved the minimum temperature in the allotted time. Due to the thermal stability of K/C gels (Tye, 1991), it may be theorized that the patties containing higher levels of gel may cook at a faster rate than those containing lesser amounts of gel.

Consumer Acceptability

Mean values for consumer acceptance (n=53) revealed no differences in acceptability between the control (0% K/C), and the 5% and 10% K/C samples. This was apparently due to the moisture retention during cooking in the 5% and 10% K/C samples and is supported by cooking yield data. Mean values for the 15% K/C were significantly lower in acceptability than either the control or the other two samples ($p\leq0.05$). One factor that may attribute to the reduced acceptance of the 15% K/C sample is that fat provides lubrication during mastication (Hedrick *et al.* 1994). Therefore, consumers may get the perception that the meat is dryer than it really is. Other studies (Cross *et al.*, 1980; Berry and Leddy, 1984; Troutt *et al.*) where ground beef patties were manufactured with less than 10% fat content found them to be less palatable and satisfying than those with fat levels above 10%.

Analysis of purchase intent revealed mean values for the 15% K/C to be significantly lower ($p\leq0.05$) than either the 5% K/C or 10% K/C, while purchase intent for 0% K/C was significantly higher than that of all other samples. There was no difference in purchase intent between the 5% and 10% K/C samples.

CONCLUSIONS

There were no significant differences ($p\leq0.05$) in cooking yields between the controls (20% fat) and the reduced fat samples (5,10 and 15% fat) containing K/C gels. Thus, results demonstrated that the K/C gels were effective in binding water during cooking. In contrast to earlier studies using meat systems without added water binders, the K/C gels did not alter the rate of cooking.

Results indicated that additions of the K/C gels could be utilized to reduce fat levels in a ground meat system to 10 and 15% without any significant ($p\leq0.05$) effect upon acceptability. Further reduction of the fat level to 5% by adding the K/C gels, however, resulted in a significant reduction ($p\leq0.05$) in acceptability.

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