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Effect of Lean Percentage on Cook Loss, Product Yield, and Cost of Common Ground Meat Products

Abstract

Ground meat is a significant component of the U.S. retail meat market, and consumers have many choices. Consumer preferences are influenced by factors such as nutritional goals, flavor, and cost, with an inverse relationship often observed between raw fat content and retail price. Three levels of lean were selected for this project: 73% ground beef, 85% ground pork, and 90% ground beef. Samples were prepared as patties or crumbles. Analysis of cook loss, moisture, crude fat, and cost of yield was conducted. Product form affected cook loss, with crumbles exhibiting higher cook loss than patties. An interaction of raw product lean percentage and product form influenced moisture and crude fat content of cooked products. Cost analysis revealed that leaner products were more costly per pound of cooked yield.

Keywords: Beef, Cost, Ground Meat, Pork, Yield

Introduction

Ground meat products are a major component of the U.S. retail meat market, with ground beef accounting for 50.6% of beef sales by volume and 39.2% by value (Beef It's What's for Dinner, 2024). Ground beef is defined as “chopped fresh and/or frozen beef with or without seasoning and without the addition of beef fat as such and shall not contain more than 30% fat” (USDA, 2012). Pork sausage is regulated to a minimum of 50% lean, but no standard is published for lean percentage of generic ground pork. However, most ground pork follows the beef standard of no more than 30% fat. This regulatory standard ensures consistency in labeling and composition, allowing consumers to make informed purchasing decisions.

Consumers have access to a range of lean-to-fat ratios and species of ground meat products, including pork, beef, bison, lamb, and poultry. Consumer preferences and purchasing decisions are influenced by nutritional goals, flavor, intended product use, and cost. The USDA (2025) reports that food-at-home prices increased by 2.4% from June 2024 to June 2025. Year-over-year beef prices increased 10.6% for that same timeframe, with beef accounting for 3.4% of food at home costs. In contrast, pork prices held relatively steady with a 0.5% year-over-year increase in June 2025 (USDA, 2025).

An inverse relationship typically exists between fat content and retail price, with leaner ground products often priced higher per pound than fattier products within each species (Beef It's What's for Dinner, 2024). However, ground products with greater fat content are known to experience more moisture and fat loss during cooking, which can result in lower final product yield. Berry and Leddy (1997) examined the effects of fat content and cooking methods on beef patty composition and found that higher-fat patties had significantly greater cook loss than leaner options, particularly when prepared using certain cooking methods. This suggests that leaner meat may retain more product mass after cooking, potentially offering better value despite higher initial cost.

Although pork is viewed as a cost-effective alternative to beef, fewer studies have compared pork and beef cooking yields across different leanness levels. Additionally,

the form in which ground meat is cooked, patties versus crumbles (e.g. burger vs tacos), may impact cook loss, further influencing consumer-perceived value.

While strong data exist on sales trends and cooking characteristics of ground meat products, the authors were unable to identify any recent studies that assessed cooking yield alongside cost-effectiveness across species and lean-to-fat ratios. This study addresses that gap by comparing cook loss and proximate composition of 85% lean ground pork, 90% lean ground beef, and 73% lean ground beef, with the aim of identifying the most cost-effective protein choice for consumers. Both beef and pork were utilized in this study as they are commonly available ground meat products. The authors realize that a limitation of this study is that beef and pork have different fatty acid profiles. However, as the product was cooked to temperatures above the melting point and below the smoke point for both species, we don't anticipate vast differences in the cooking processes that will impact final results.

Materials and Methods

Three types of ground meat products were evaluated in this study: 85% lean ground pork (n = 10), 90% lean ground beef (n = 10), and 73% lean ground beef (n = 10). Each sample was divided into three 150 g portions. One portion remained raw to be vacuum sealed and stored until proximate composition analysis. This portion was used to confirm the raw percent lean indicated on the packaging. The second was formed into a 9 cm diameter patty and cooked on a clamshell grill (George Foreman Grilling Machine Model: GRS6090B) to an internal temperature of 71°C. The third portion was cooked in an electric skillet (Rival Model: CKRVSK11) as a crumble until fully browned. Cooked samples were rested on clean paper towels to drain and cool prior to packaging.

Cook loss was calculated as the difference between raw and cooked weight after cooling and expressed as a percentage of raw weight.

All samples were frozen at -18°C for 24 hours, then transferred to long-term storage at -15°C until further analysis.

Frozen samples were individually diced and flash-frozen in liquid nitrogen, then ground into a fine powder (Waring Commercial Blender Model: 7011S). Each powdered sample was stored in a sterile bag and held at -15°C until analysis.

For moisture analysis, 5 grams of each sample were weighed into pre-weighed aluminum tins (Fisher Aluminum Weighing Dishes, Model #08-732-101, Hanover Park, IL) lined with filter paper (Cytiva Whatman Qualitative Filter paper 55mm, Model #09-805B). Tins were crimped closed and placed in a drying oven at 100°C for 24 hours. After drying, samples were cooled in a desiccator (Bel Art Space-Saver Desiccator, Wayne, NJ, Model #10-987-059) for 1 hour and reweighed to determine moisture loss.

Crude fat content was determined using Soxhlet extraction. Dried samples (after moisture analysis) were loaded into a Soxhlet apparatus, where petroleum ether was used as the solvent. Samples were extracted for 72 hours, during which ether was heated, vaporized, condensed, and cycled over the samples to extract fat. After extraction, samples were placed under a fume hood for 1 hour to allow excess ether to evaporate, then dried in a drying oven at 100°C for 5 hours. Samples were cooled in a desiccator for 1 hour before the final weight was recorded.

Cost of cooked product was calculated by dividing the retail price by the cooked yield and is extrapolated to a per pound basis. Retail price was averaged over two purchase periods. Additionally, the price of 85% lean ground beef was also recorded for discussion purposes of the cost effectiveness of ground beef products. Prices used for analysis were $5.44/lb for 73% lean, $6.92/lb for 85% lean, and $7.88/lb for 90% lean.

Data were analyzed using the MIXED procedure of SAS. Fixed effects were percent lean, product form (patty vs. crumble), and their interaction. Interactions are reported when significant. Dependent variables were cook loss, moisture content, crude fat content, and cost of cooked product. LS Means were separated with a Tukeys adjustment when significant. Significance was determined at $P \leq 0.05$.

Results and Discussion

Cook loss

No interaction of percent lean and product form was observed for cook loss. A main effect of percent lean was observed ($P < 0.0001$; Table 1). Product that was 73% lean had increased cook loss compared to 85% ($P = 0.0003$) and 90% lean ($P < 0.0001$). There was no difference in cook loss between 85% and 90% lean ($P = 0.25$). A main effect of product form was observed ($P < 0.0001$; Table 2) where crumbled products had substantially increased cook loss compared to patties. These results indicate crumbles experience significantly more water and fat loss during cooking than patties, likely due to the increased surface area and less structural integrity.

Table 1. LS Means for the effect of percent lean of ground products on cook loss and cost per pound of cooked yield.

Variable	73% Lean	85% Lean	90% Lean	SEM	*P* – value
Cook Loss, %	40.39[a]	34.63[b]	32.42[b]	1.38	< 0.0001
Cost / lb, $	9.32[c]	10.81[b]	11.80[a]	0.25	< 0.0001

[abc] Means lacking common superscripts differ $P \leq 0.05$

Table 2. LS Means for the effect of product form of ground products on cook loss and cost per pound of cooked yield.

Variable	Crumble	Patty	SEM	*P* – value
Cook Loss, %	42.98	28.65	1.13	< 0.0001
Cost / lb, $	11.86	9.43	0.21	< 0.0001

Moisture

A percent lean by product form interaction was observed for cooked product moisture content ($P = 0.02$; Figure 1). Crumble from 85% lean and crumble from 73% lean were similar to each other ($P = 0.25$) and had the least amount of moisture content compared to all other products ($P < 0.01$). Crumble from 90% lean had similar moisture content to patties from 73% lean ($P = 0.14$) but less moisture than patties from 85% and patties from 90% lean products ($P = 0.0034$ and $P < 0.0001$ respectively). Moisture content of 73% and 80% lean patties was similar ($P = 0.72$) and decreased compared to 90% lean

patties (P = 0.0002 and P = 0.0149, respectively). Patties made with 90% lean product had the most moisture of all combinations (P < 0.01 for all).

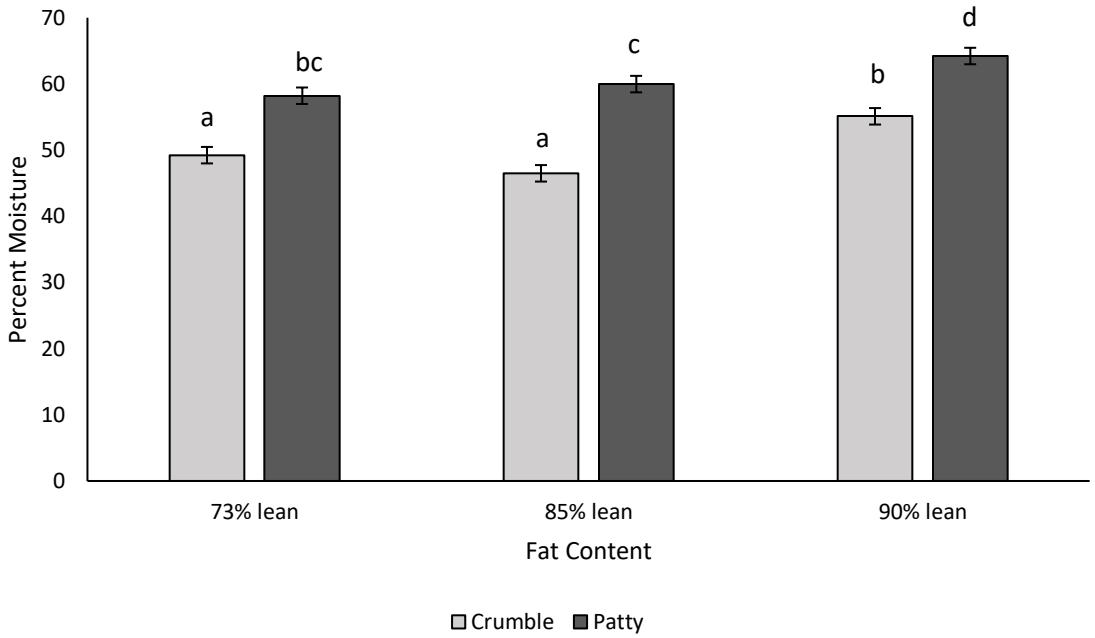

Figure 1. LS Means for percentage of moisture remaining in 73%, 85%, or 90% lean ground product cooked as a patty or crumble (P = 0.02). [abcd] Bars lacking common superscripts differ P < 0.05.

These findings suggest that patty forms generally retained more moisture than crumbles, and that leaner products generally retained more moisture. These data support the cook loss data as less cook loss was observed for patties than crumbles. This is likely due to the decrease in surface area for patties compared to crumbles, allowing for more moisture to be retained through the cooking process.

Crude Fat

Crude fat content of raw samples was 29.1% ± 2.4% for 73% lean, 16.6% ± 4.8% for 85% lean, and 10.4% ± 2.5% for 90% lean. This confirms that while products may be marketed at specific lean percentages, variability still exists from package to package. USDA labeling guidelines allow for a variance of 20% from listed nutrient values based on the gram/microgram weight declared on the nutrition facts label (USDA, 2024). Additionally, as ground beef cannot exceed 30% fat, no variance above 30% is allowed.

Based on the data in this study, each of the three blends appeared to be close to, but above, the allowed fat content for each label. However, as each portion was one-third of a package, it is possible that variation within the package could still exist.

A lean percentage by product form interaction was observed for crude fat of cooked products ($P = 0.02$; Figure 2). Patties made with 90% lean had the least amount of crude fat compared to all other combinations ($P < 0.008$ for all). Crumble made with 90% lean and patties made with 85% lean were similar ($P = 0.67$) but contained less crude fat than both 73% lean products and 85% lean crumble ($P < 0.001$ for all). Patties made with 73% lean were similar to 85% lean crumble ($P = 0.17$) but had less crude fat than crumble made with 73% lean ($P = 0.04$). Crumbles made from 85% and 73% lean had similar crude fat ($P = 0.99$).

As expected, products made with 90% lean had less fat than products made with 73% lean, and 85% lean products were intermediate. However, the similarity between crude fat in 85% and 73% lean crumble indicates that there may be a threshold in the amount of fat that can be retained in cooked crumble products.

Cost of cooked product

No fat content by form interaction was observed for the cost of cooked product. A main effect of lean percentage was observed ($P < 0.0001$; Table 1). Price per pound of cooked product increased linearly with the percent lean of raw product ($P < 0.001$ for all). Cost of 73% lean was $9.32/lb, 85% lean was $10.81/lb, and 90% lean was $11.80/lb. Additionally, a main effect of form was also observed ($P < 0.0001$; Table 2). Patties cost $9.43/lb while crumbles cost $11.86/lb.

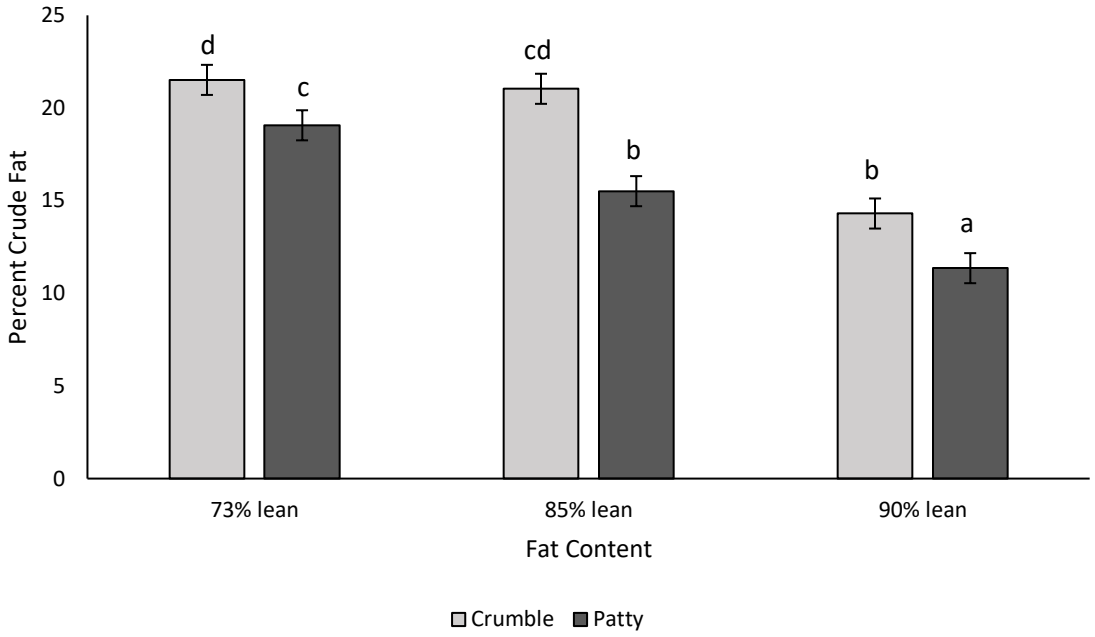

Figure 2. LS Means for percentage of crude fat remaining in 73%, 85%, or 90% lean ground product cooked as a patty or crumble ($P = 0.02$). ^{abcd} Bars lacking common superscripts differ $P < 0.05$.

These results indicate leaner products are more costly per pound of cooked yield, and form directly affects cost when considering yield, with patties retaining more weight post-cooking than crumbles. This highlights the importance of considering composition and preparation method when evaluating effectiveness within a consumer budget.

Conclusion

This study provides an analysis of how lean percentage and product form influence cook loss, crude fat, moisture content, and cost in ground meat products. The results clearly demonstrate that product form and raw lean percentage greatly impact all of the variables evaluated. However, the cost per yield of cooked product did not follow what most consumers would generally expect from ground products. Many consumers assume that while the leaner ground products cost more up front, they will get a better value with less cook loss than fattier ground products. These data indicate that with

current beef prices, products with increased fat are the better value at the time of this study. It is important to acknowledge that price is not the only driver in consumers' purchasing decisions, and many consumers prefer to begin with leaner products for health reasons. These data indicate that the amount of fat remaining in cooked product depends on both initial lean percentage and cooked form. This indicates that consumers may potentially save money by purchasing products with a lower lean percentage while still ending with products of similar fat content when cooked. As this was a pilot study, additional research is warranted to determine if there is further variation in ground products by source plant, species, fresh vs frozen storage, or additional cooking methods.

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