

THE EFFECT OF COOKING SPEED ON MEAT TENDERNESS

Tukhtaev Sayfiddin Fakhriddinovich

Culinary Expert

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Abstract

Cooking speed plays a major role in determining the tenderness and juiciness of meat. When meat is heated quickly at high temperatures, muscle proteins contract rapidly, leading to moisture loss and a tougher texture. When meat is cooked slowly at lower temperatures, collagen in the connective tissue has time to dissolve into gelatin, resulting in a more tender and moist product. This study compared fast, high-temperature cooking with slow, low-temperature cooking to examine how these different heating rates affect tenderness. Tenderness was assessed by measuring the pressure needed to break the cooked meat fibers, along with observations of texture and juiciness. The results showed that fast-cooked samples had significantly higher resistance to pressure, indicating greater toughness, while slow-cooked samples required much less force and showed clear signs of collagen breakdown. These findings support previous scientific studies on heat-induced protein changes and collagen solubilization in meat. The study demonstrates, in practical terms, how cooking speed influences tenderness and why slower methods produce softer meat.

Keywords: *meat tenderness; cooking speed; slow cooking; fast cooking; collagen breakdown; protein denaturation; moisture loss; heat treatment; food texture; meat science*

1. Introduction

Meat tenderness is one of the most important characteristics that determine eating quality. The way heat travels through meat during cooking affects how proteins and connective tissues change. Fast cooking at high temperatures causes rapid denaturation of muscle proteins, leading to strong shrinkage of the fibers and pressing out moisture. This reaction is well documented in meat science, which shows that myofibrillar proteins contract sharply when heated quickly above 60–70 °C (Tornberg, 2005). As a result, meat cooked rapidly often becomes firm and dry.

In contrast, slow cooking allows heat to penetrate gently and gives collagen—the main connective tissue in meat—enough time to convert into gelatin. Collagen begins to dissolve at temperatures between 70–80 °C when maintained over longer periods (Penfield and Meyer, 1975). Gelatin softens the texture and increases juiciness. Studies on sous-vide and slow heating have shown significant improvements in tenderness when meat is cooked slowly at moderate temperatures (Roldán et al., 2015).

Understanding how cooking speed affects these internal structural changes helps explain why some methods produce tender results while others create toughness. This study compares fast and slow cooking speeds to highlight how heating rate influences tenderness.

2. Materials and Methods

Beef shoulder was selected due to its relatively high collagen content, making differences between cooking speeds easier to observe. Pieces of similar size were prepared to ensure consistent cooking conditions. Fast-cooked samples were placed in an oven preheated to 220 °C and heated until reaching an internal temperature of 75 °C. Slow-cooked samples were heated at 90 °C for several hours until reaching the same internal temperature.

Tenderness was assessed using a simple pressure test modeled on shear-force principles commonly used in meat science research, which measures how easily fibers break apart after cooking (Penfield and Meyer, 1975). Observations of juiciness, color, and structure were recorded to describe qualitative differences between cooking methods.

3. Results

Fast-cooked samples required considerably more pressure to break apart, indicating higher toughness. Muscle fibers appeared tightly packed, and the surface was drier compared to slow-cooked samples. This behavior matches scientific findings showing that rapid heating causes strong fiber shrinkage and moisture loss (Tornberg, 2005).

Slow-cooked meat samples were noticeably softer, breaking apart with much less pressure. The texture appeared moist, and connective tissues were gelatinized. This aligns with research showing that slow cooking promotes collagen breakdown and increases tenderness (Penfield and Meyer, 1975; Roldán et al., 2015).

Table 1. Comparison of Meat Tenderness Under Fast and Slow Cooking

Cooking Method	Internal Temp.	Cooking Speed	Tenderness (Pressure Needed)	Observed Texture	Interpretation
Fast cooking (220 °C)	75 °C	High	High pressure required (tough)	Dry, tight fibers	Rapid shrinkage and moisture loss
Slow cooking (90 °C)	75 °C	Low	Low pressure required (tender)	Moist, soft fibers	Collagen breakdown into gelatin

4. Discussion

The results clearly show that cooking speed affects meat tenderness due to differences in protein shrinkage and collagen behavior. Fast cooking causes the muscle proteins to contract quickly, leading to moisture loss and a firmer texture. Scientific studies confirm that this rapid heating increases toughness because myofibrillar proteins shrink intensively at higher temperatures (Tornberg, 2005). Connective tissue remains mostly intact during fast cooking because collagen does not have enough time to dissolve.

Slow cooking, however, allows both moisture retention and collagen solubilization. Because heat penetrates slowly, muscle fibers shrink less severely, and collagen gradually converts to gelatin, improving tenderness and juiciness. This is consistent with studies showing that low-temperature, long-time cooking enhances meat tenderness through controlled protein denaturation and collagen softening (Penfield and Meyer, 1975; Roldán et al., 2015).

These findings demonstrate why slow cooking methods—such as braising, stewing, sous-vide, or low-temperature roasting—are especially beneficial for tougher meat cuts. Cooking speed is therefore a key factor that strongly influences meat texture and should be selected according to the desired tenderness.

5. Conclusion

Cooking speed has a significant impact on meat tenderness. Fast, high-temperature cooking leads to tougher meat due to rapid muscle fiber contraction and reduced time for

collagen breakdown. Slow cooking at lower temperatures produces tender, moist meat because it allows collagen to dissolve into gelatin and prevents severe protein shrinkage. Understanding these effects helps cooks choose the right cooking method for each cut of meat and achieve optimal tenderness.

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