The Characterisation of key Processes In Sous Vide Meat Cooking

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Abstract

Sous vide (French for “under vacuum”) is a method of cooking under precisely controlled conditions, which employs the principles of long-time-low temperature treatment. Better control over texture, flavour, and doneness are a few of the numerous advantages that sous vide enjoys over traditional methods of cooking.

However, the requirement of a long time makes the sous vide process often uneconomical at industrial scale, particularly when applied to tougher cuts of meat, briskets for example. To improve the economics of the process, it is essential to better characterise the sous vide process, specifically understanding the cook-loss, how different conditions affect the extent of collagen dissolution and tenderisation will enable products with better sensory to be produced. The aim of the current work was, therefore, to characterise the key processes in order to facilitate the optimisation of sous vide cooking.

Samples of beef semitendinosus (‘eye of round’) were cut into blocks of approximately 60x60x100 mm and were cooked at 50—60 °C (in increments of 2 °C), 70, 80, and 90 °C for five time-points: 1.5—73.5, 1.5—49.5, 1.5—25.5, and 1.5—9.5 hours, respectively. Cook-loss (CL), Warner—Bratzler shear force (WBSF), total collagen in raw samples (TC), cook-loss-heat-soluble collagen (CLDC), and percent dissolved collagen within the cooked meat (%CMDC) were all measured (a new method was developed for determining %CMDC as no existing methods were found). Kinetic models were developed for the rate of CL and the CLDC as a function of temperature.

A rapid cook-loss (which was attributed to the denaturation of myofibrillar proteins) followed by slow phase was observed for all temperatures. The higher temperatures (70—90 °C) showed a similar equilibrium cook-loss of approximately 42%. The cook-loss of the lower temperatures did not, however, equilibrate but showed an increasing trend with increasing temperature. The WBSF measurements showed a sharp increase (from the raw measurements) then sharp decline, followed by a slow decline phase. The TC was found to be 35 mg-collagen/g-meat. The CLDC increased with both time and temperature – the

highest measured value was 3.15 mg-collagen/ml-cook-loss (80 °C, 25.5 hours). This value is very low compared to the TC and therefore CLDC is not an accurate measure of the dissolved collagen within the meat. The %CMDC increased with increasing temperature and to a lesser extent the time – the maximum %CMDC was 80% (90 °C, 9.5 hours). A two reaction, non-isothermal, first order (with fitted kinetic parameters) system was found to satisfactorily model both the CL and CLDC.

Although the mechanism of meat tenderisation is complex, the dissolution of collagen, the denaturation of myofibrillar proteins, and the level of cook-loss appear to be the key factors influencing the tenderness of the resulting meat.

The developed conceptual model integrates the key factors and shows how these undergo changes as the temperature is increased, but further research is required to elucidate these and to develop tools to rapidly identify processing conditions for different meat cuts and products.

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To my family and friends, thank you for your love and support.

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In a bitterly cold November evening, Dr Hannibal Lecter walked into a small, poorly lit butchery in New York City. To the good doctor's amazement and delight, he noticed that three sous vide human brains are on display for sale: a German brain for $300, a Japanese one for $450, and a Somali one for $900. He pointed to the display cabinet and asked the shopkeeper "why is the Somali brain so expensive?" To which the shopkeeper replied, "because it is hardly used!"

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