

Freezing with liquid nitrogen

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In Hungary, at the Central Food Research Institute experiments were carried out on the investigation of the liquid nitrogen spray freezing system.

Now, briefly I should like to review the experimental results of freezing of beef cuts.

The freezing experiments with beef cuts were aimed on the one hand, at the comparison of liquid nitrogen spray freezing with air blast freezing and, on the other, at the investigation of the effect of freezing rate on meat quality.

Liquid nitrogen spray freezing was performed in a tunnel system experimental equipment. The slices of meat were frozen first by reducing their temperature to -1°C by the introduction of cold nitrogen gas, and then adjusting the final temperature to -30°C by spraying liquid nitrogen on the surface of the slices.

For air blast freezing too, a tunnel system experimental equipment was used, in which the air temperature was -40°C , and the flow rate of air was 1.8 m/sec. The final freezing temperature of the meat slices was the same as in the experiment with liquid nitrogen, namely -30°C .

In the freezing experiments the thickness of the sliced beef was 2 cm, their weight was between 170 and 200 g. The slices were frozen without preliminary cooking or packing.

In order to determine and to compare the effects of freezing rates on meat quality we investigated the weight loss, drip loss, cooking loss, colour, texture and sensory evaluation. To compare the liquid nitrogen freezing and the air blast freezing systems, the freezing time and the average linear freezing rate were investigated.

Weight loss during freezing was determined by weighing the individual slices before and after freezing.

For the determination of drip loss, frozen slices of meat of known weights were packed into moisture proof plastic pouches. Thawing temperature was 1°C , thawing period was 48 hours.

For the determination of cooking loss, the frozen meat slices were packed into aluminium foil bags. After thawing the slices were heat treated at 180°C , for one hour. Loss of cooking was determined from the weight loss during heat treatment.

The colour of samples was determined before and after freezing using Gardner's Colour Difference Meter.

The texture of the samples was determined before and after freezing, using the Instron equipment. Before the experiment the slices were sealed bags, then the samples were heated to 80 °C, for one hour. After heat treatment 1 × 1 × 2 cm sections of samples were compressed between 1 cm jaws.

The sensory evaluation of cooked meat was performed by a panel of ten members, using the triangular testing procedure. Appearance, taste, tenderness and juiciness were investigated.

The freezing time was determined by the temperature the core of slices between + ten and - 30 °C.

The average linear freezing rate was determined from the freezing curves by the temperature of the core between 0° and -5 °C.

From the freezing experiments the following more important results were obtained:

At first: The freezing times and freezing rates obtained. The freezing time was 20 minutes in the case of liquid nitrogen spray freezing, and 40 minutes in the case of air blast freezing.

The average linear freezing rate was 15 cm/hour in the case of liquid nitrogen and 4 cm/hour in the case of air blast freezing.

Secondly: The effect of freezing rate on the quality of frozen sliced beef.

The results of the experiments have shown that weight loss during freezing was significantly lower when liquid nitrogen spray freezing was used, namely 1.0%, than in the case of air blast freezing, namely 1.5%.

No significant difference was found in thawing drip losses applied the liquid nitrogen and air blast freezing systems, namely 3.9% and 4.3%.

While the loss on cooking of meat frozen by liquid nitrogen process was somewhat higher than of the meat processed by the other system.

The total weight loss during freezing, thawing and cooking was practically same in the range of 4 to 15 cm/hour average linear freezing rates.

After thawing the colour of the meat frozen by liquid nitrogen spray system was according to the results of instrumental measurement slightly paler, but the difference was not perceptible to the naked eye.

There was no significant difference in the textures and eating qualities of the meat slices frozen by the two different systems.

From these results it has been found that in the case of liquid nitrogen spray freezing system, the freezing time was 50% shorter, and it gave about four times faster freezing rate than the air blast freezing.

No difference was found in the quality of sliced beef between 4 and 15 cm/hour average linear freezing rates.

Zmrazovanie kvapalným dusíkom

Súhrn

Autor, pracovník ústredného výskumného ústavu potravinárskeho v Budapešti, oboznamuje s výsledkami zmrazovania hovädzích rezňov, 2 cm hrubých o váhe 170—

200 g. Zmrazoval sprejovo kvapalným dusíkom a v prúde chladného vzduchu. Sledoval dobu zmrazovania, lineárnu rýchlosť, váhovú stratu, farbu, kvalitu tkaniva a senzorické vyhodnotenie. Pri zmrazovaní kvapalným dusíkom bola doba 2-razy kratšia a lineárna rýchlosť 4 razy väčšia a váhová strata o 50 % menšia. V ostatných ukazovateľoch boli výsledky zhruba rovnaké.

Замораживание с помощью жидкого азота

Выводы

Автор, работник Центрального научно-исследовательского института пищевой промышленности в г. Будапеште, приводит результаты замораживания говяжьих отбивных котлет, толщиной в 2 см и весом в 170—200 г. Замораживание происходило с помощью распыляющего жидкого азота и в струе холодного воздуха. Он изучал продолжительность времени замораживания, линейную скорость, потери в весе, цвет, качество ткани и органолептическую оценку. При замораживании жидким азотом продолжительность времени была в два раза короче, линейная скорость вчетверо больше и потери в весе на 50 % меньше. У остальных показателей результаты были приблизительно одинаковы.