HydroFresh®

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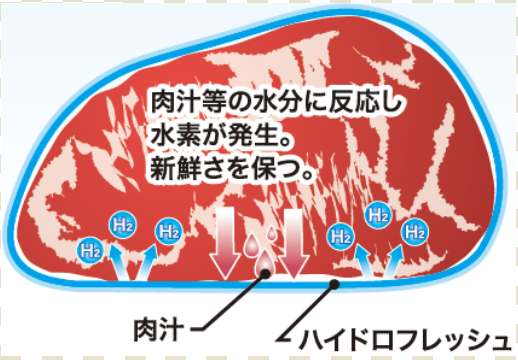

[1. Introduction]

Aged meat is experiencing a surge of popularity. Although there is no clear definition of aged meat, the edible meat treated as required and adequate for aging and stored under a controlled environment suitable for aging for a certain period of time is often called aged meat. It is generally said that, when edible meat is aged, one of the umami ingredients “glutamic acid” contained in edible meat increases and the meat gets soft.

The methods for aging edible meat include: dry aging and wet aging. In dry aging, edible meat is stored in a dry ventilated warehouse under a controlled temperature and humidity for aging. With this method, special flavor can be obtained, whereas there is a risk that the edible meat may become rotten if the aging environment is not controlled properly and the cost may increase because yields are low. In wet aging, edible meat is vacuum-packed for aging. Compared to dry aging, effort to control the aging environment and has high yields and is thereby used more commonly.

The new product that we developed and introduces in this technical report is a vacuum packaging film for wet aging that is made by adding a function of generating molecular hydrogen to an existing film. It is almost confirmed that one of the umami ingredients “glutamic acid” contained in edible meat increases and the meat gets soft when the meat is vacuum-packed with this film because the resulting molecular hydrogen diffuses in the edible meat.

[2. Development concept]

In 2007, Ikuroh Ohsawa, Shigeo Ohta, et al. reported medical effectiveness of molecular hydrogen in an internationally prominent medical journal “Nature Medicine”[1]. It is being revealed that hydrogen functions as an effective anti-oxidant in vivo and can be applied to antioxidation treatment and prevention.

We considered whether it is possible to prevent oxidation of edible meat by the action of molecular hydrogen to maintain freshness of the edible meat. Focusing on vacuum packaging widely used for the distribution of edible meat, we devised as a development concept a new type of vacuum packaging film enabling generation of molecular hydrogen, to prevent oxidation of edible meat.

[3. Mechanism of molecular hydrogen generation and diffusion of the resulting molecular hydrogen into edible meat]

We focused on metal particles as a material that enables generation of hydrogen and can be added to a film. Metal particles react with water (drip for edible meat) to form a metal oxide or hydroxide and molecular hydrogen at the same time.

Chemical equation of metal and water (an example)
* M: Metal

$$2M + 6H_2O \rightarrow 2M(OH)_3 + 3H_2$$

Metal particles are kneaded into a polyethylene resin and dispersed evenly in the entire film with our proprietary core technology. Fig. 1 shows a cross-sectional image of the developed product, HydroFresh®. The light gray area in the image is the polyethylene resin portion and white objects seen in the portion or on the surface are metal particles. The water passing through the film reacts with the metal particles dispersed in the film to form molecular hydrogen. The resulting molecular hydrogen is then released to the outside through the film. The released molecular hydrogen is soluble in water and fats because it is small in size and has no polarity. For this reason, the molecular hydrogen passes through cell membranes and is quickly diffused into entire edible meat.

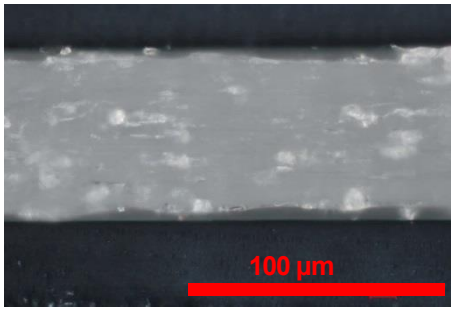

Fig. 1 Cross-sectional image of HydroFresh®

[4. Verification of hydrogen generation performance in HydroFresh®]

Fig. 2 shows chronological change in concentration of dissolved hydrogen.

A sealed container containing water and HydroFresh® was stored at room temperature and concentration of hydrogen dissolved in the water was periodically measured by the diaphragm electrode method.

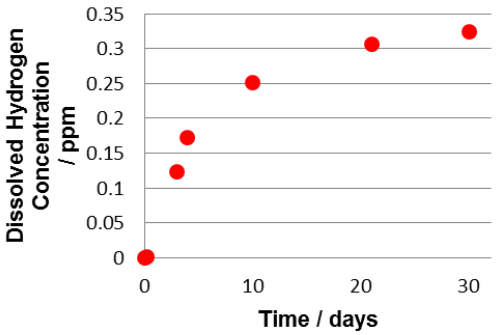

Fig. 2 Chronological change in concentration of dissolved hydrogen

It was observed that concentration of hydrogen dissolved in the water increased over time.

[5. Evaluation of beef packed with HydroFresh® for storage]

○ **Preventing discoloring of beef**

Fig. 3 shows a photo of commercially prepared beef round wrapped with HydroFresh® stored in a refrigerator for a week.

Fig. 3 Left: blank, right: HydroFresh®

While the blank beef (left) turned brown, the red color of the beef wrapped with HydroFresh® (right) was maintained. It is assumed that, in the beef wrapped with HydroFresh®, the oxidation reaction that the muscle pigment myoglobin is oxidized to metmyoglobin (brown) was inhibited. We aim to promote buying motive of consumers by inhibiting discoloration of beef.

○ **Making beef taste better**

Fig. 4 shows the results from measurements of the umami ingredient “glutamic acid” contained in beef packed with HydroFresh® and aged for a given number of days. The vertical and horizontal axes show the amount of the umami ingredient, glutamic acid of beef, and the number of days elapsed respectively.

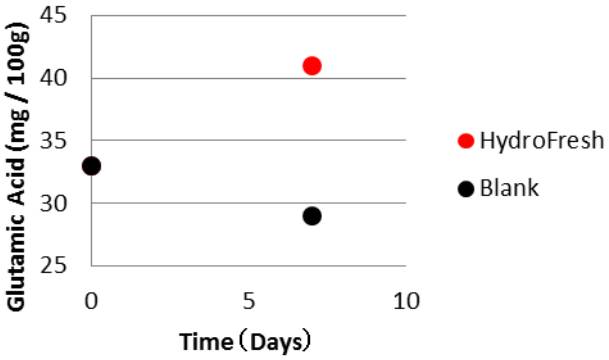

Fig. 4 Amount of the umami ingredient, glutamic acid, contained in beef

Surprisingly, the amount of the umami ingredient “glutamic acid” contained in the beef packed with HydroFresh® increased about 25% compared to that of the blank. This suggested a new effect of molecular hydrogen on beef. The above results allowed us to present the new type of vacuum packaging film that inhibits discoloration of beef and increases the umami ingredient contained in beef.

The reason that the amount of glutamic acid in beef increased is unknown for the time being; therefore, we have been working on this matter in cooperation with a public organization to clarify the mechanism.

[6. Future prospects]

By reviewing our core technologies and further taking a cue from the advanced research of molecular hydrogen medicine, we succeeded in presenting a film incorporating a novel idea, the packaging film enabling the generation of hydrogen. In the evaluation of the film, not only the originally intended effect but also the effect of an increased umami ingredient that nobody could expect were confirmed. It is required to clarify the mechanism as soon as possible as there have been many questions, including how molecular hydrogen acts on edible meat to produce the effect.

Besides beef, it was also confirmed experimentally that the amount of glutamic acid in pork packed with the developed film increased. In the future, we will verify whether we can apply the vacuum packaging film to edible meat other than beef and pork, including fish, aiming to find potentials of molecular hydrogen.

[References]

[1] Ohsawa Ikuroh, Msahiro Ishikawa, Kumiko Takahashi, Megumi Watanabe, Kiyomi Nishimaki, Kumi Yamagata, Kenichiro Katsura, Yasuo Katayama, Sadamitsu Asoh, Shigeo Ohta., *Nature Medicine*, **13**, 688-694, **2007**.