Faktoren, die die mangelhafte Haltbarkeit des DFD - Fleisches bestimmen

COLIN O. GILL and KENNETH G. NEWTON

Meat Industry Research Institute of New Zealand (Inc.), Hamilton, New Zealand

Die schlechte Haltbarkeit des DFD-Fleisches wird gewöhnlich der Tatsache zugeschrieben, dass Verderbsbakterien bei dem hier vorliegenden hohen pH-Endwert schneller wachsen. Die Wachstumsraten vieler Verderbsbakterien werden aber im pH-Bereich von 5.5 bis 7.0 nicht beeinflusst, auch wenn die lag-Phasen bei den niedrigeren Werten etwas verlängert sind. Es wurde nachgewiesen, dass Pseudomonaden, die unter aeroben Bedingungen und bei entsprechender Feuchtigkeit unter der Verderbsflora vorherrschen, beim Wachstum auf Fleich als eistes Glucose angreifen. Dieses Wachstum vollzieht sich auf der Fleischoberfläche. Sobald nun aus den tieferen Schichten nicht mehr genügend Glucose an die Oberfläche diffundiert, werden von den Bakterien Aminosäuren abgebaut. Erst zu diesem Zeitpunkt wird der für den Verderb typischen Geruch wahrnehmbar.

DFD-Rindfleisch-Scheiben ohne Glucosereserven mit einem pH-Wert von 6.3 wurden mit L-Milchsäure oder mit Glucoselösung behandelt, um die normalen Konzentrationen dieser Komponenten herzustellen. Behandelte und unbehandelte DFD-Fleischscheiben sowie Scheiben von Rindfleisch normaler Zusammensetzung wurden mit einem fluorescierenden Pseudomonad-Stamm beimpft. Bei dem säurebehandelten (pH 5.6) und dem unbehandelten Fleisch trat ein Verderbsgeruch bereits bei einer Zelldichte von $10^6/cm^2$ auf, während bei normalem und bei glucose-behandeltem DFD-Fleisch Verderbserscheinungen erst auftraten, wenn die Keimzahlen höher als $10^8/cm^2$ lagen. Die Wachstumsraten der Bakterien waren in allen Fällen die gleichen.

Die Glucosekonzentration schwankt im Rindfleisch äusserst stark. Bei einem pH-Wert von 6.0 kann der Glucose-gehalt bereits erschöpft sein; bei pH 6.4 ist Glucose niemals vorhanden. Da der Glucosegehalt die Haltbarkeit des DFD-Fleisches bestimmt, sollte olieser Parameter eher als der pH-Wert zur Beurteilung der DFD-Kondition genützt werden.

The factors determining the poor keeping qualities of D.F.D. Meat

COLIN O. GILL and KENNETH G. NEWTON

Meat Industry Research Institute of New Zealand, Hamilton, New Zealand

The poor keeping qualities of DFD meat are usually attributed to faster growth of spoilage bacteria at the high ultimate pH of meat in this condition. However, the growth rates of most spoilage bacteria are unaffected by pH in the range 5.5 to 7.0, although the lag phase may be extended at the lower end of this range. It had been shown that pseudomonads, which are the dominant spoilage organisms under humid aerobic conditions, utilize glucose initally when growing on meat. Growth occurs at the meat surface, and when the rate of glucose diffusion from the bulk meat to the surface can no longer meet the demands of the bacteria, amino acids are degraded. It is only at this stage that spoilage odours begin to be detected.

Slices of DFD beef, pH 6.3 and devoid of glucose, were treated with L-lactic acid or with glucose solution to give the normal concentrations of these components. Treated and untreated DFD slices and slices of beef of normal composition were inoculated with a fluorescent pseudomonad. With the acid-treated (pH 5.6) and untreated DFD meat, spoilage odours were detectable with a bacterial cell density of $10^6/cm^2$, but with normal meat and glucose-treated DFD meat, spoilage was not detected until bacterial numbers exceeded $10^8/cm^2$. The bacteria grew at the same rate in all cases.

Glucose concentration in beef is highly variable and glucose may be exhausted in beef with a pH as low as 6.0; at pH 6.4 glucose is always absent. Since glucose is the factor which determines the keeping quality of DFD meat, this parameter rather than pH should be used to define the DFD condition.

A 4:2

Les facteurs determiner la pauvre conservation quality de la viande DFD

COLIN O. GILL et KENNETH G. NEWTON

Meat Industry Research Institute of New Zealand, Hamilton, New Zealand

La pauvre conservation qualité de la viande DFD sont habituellement attribuer à la rapide multiplication des microorganisms désadvantaquex à la pH haute de cette viande. Cependant, avec plupart des microorganisms désadvantaquex le pH de 5.5 - 7.0 est sans effet sur cours de multiplication, bien que la condition de lag peut étendre dans l'endroit bas de la pH rangée. Il avait demontrer cette pseudomonads, qui sont le principal microorganisms désadvantaquex dans la condition humide et avac O_2, a la première utiliser glucose quand il poussé sur la viande. Croissance se passe à la surface de viande, et quand le glucose cours de change d'intérieur de viande en la surface n'accomplis pas davantage ce dont les microorganisms sont besoin, amino acids sont détruire. Mauvais odeur a commencé à cet étape seulement.

Tranches de la viande DFD, pH 6.3 et sans glucose, étaient traité avec L-lactic acid ou avec une solution glucose donner leur concentration normal. Tranches de DFD, a traité et n'a pas traité, et tranches du boeuf normal étaient injecté avec une fluorescent pseudomonad. Avec le acid-traité (pH 5.6) et n'a pas traité viande DFD, mauvais odeurs étaient découvrant avec une microorganism cell densité de $10^6/cm^2$, mais avec viande normal et glucose-traité viande DFD, n'était pas découvrant jusqu'à les numéros des microorganisms > $10^8/cm^2$. Les microorganisms poussé à la même cours de change dans tous les experiments.

Concentration de glucose dans le boeuf est variablé et glucose peut absent dans le boeuf avec une pH aussi bas que 6.0; à pH 6.4 glucose est absent toujours. Depuis glucose est le facteur qui détermine la conservation qualité de la viande DFD, concentration de glucose plutôt que pH est mieux pour défiré la condition de DFD.

Факторы, обуславливающие низкую стойкость мяса DFD при хранении

К.О.ДЖИЛЛ и К.Дж.НЬЮТОН

Научно-исследовательский институт мясной промышленности Новой Зеландии, Гамильтон, Новая Зеландия

Низкую стойкость мяса DFD при хранении обычно объясняют ускоренным ростом гнилостных бактерий при высоком конечном pH такого мяса. Однако на скорость роста большинства гнилостных бактерий не влияет pH в диапазоне 5,5–7,0, хотя нижний предел этого диапазона может обусловить более длительную лаг-фазу. Было показано, что псевдомонады, являющиеся основными гнилостными организмами во влажных аэробных условиях, при росте на мясе сначала используют глюкозу. Рост происходит на поверхности мяса, и когда скорость диффузии глюкозы из толщи мяса к поверхности не может более удовлетворять потребности этих бактерий, аминокислоты распадаются. Только на этой стадии начинают обнаруживать гнилостный запах.

Ломтики говядины DFD с pH 6,4, не содержащие глюкозы, обработали L-молочной кислотой или раствором глюкозы, чтобы обеспечить нормальную концентрацию этих компонентов. Обработанные и необработанные образцы мяса DFD, а также образцы нормальной говядины инокулировали флуоресцентными псевдомонадами. У образцов мяса DFD, обработанных кислотой (pH=5,6) и необработанных, гнилостный запах обнаруживали при обсемененности $10^6/см^2$, а у образцов нормального мяса и у образцов, обработанных глюкозой, порчу выявляли лишь при обсемененности $10^8/см^2$. Во всех случаях бактерии росли с одинаковой скоростью.

Концентрация глюкозы в говядине не является постоянной; ее запасы могут исчерпаться уже при pH=6,0, а при pH=6,4 глюкоза всегда отсутствует. Поскольку содержание глюкозы – это тот фактор, который обуславливает стойкость мяса DFD при хранении, для определения состояния DFD следует пользоваться этим параметром, а не показателем pH.

The factors determining the poor keeping qualities of DFD meat

COLIN O. GILL and KENNETH G. NEWTON

Meat Industry Research Institute of New Zealand (Inc.), Hamilton, New Zealand.

Introduction

The poor keeping qualities of DFD meat are usually attributed to faster growth of spoilage bacteria at the high ultimate pH of meat in this condition. However, the growth rates of many spoilage bacteria appear to be unaffected by pH in the range 5.5 to 7.0, although the lag phase may be extended at the lower end of this range (Gill & Newton, 1977). It has been shown that pseudomonads, which are the dominant spoilage organisms under humid aerobic conditions, utilize glucose initially when growing on meat. Growth occurs at the meat surface, and as the bacterial cell density increases, the rate of diffusion of glucose from within the meat to the surface becomes too slow to meet the requirements of the bacteria. Only then do bacteria attack amino acids, with the production of ammonia and spoilage odours (Gill, 1976). Since DFD meat is deficient in glycogen, the glucose content may also be reduced. This could result in the production of spoilage odours at an earlier stage than in normal meat.

Materials and Methods

Beef striploins graded as DFD were obtained from a local abattoir. Mutton of high ultimate pH was obtained from sheep exercised to exhaustion before slaughter.

Muscle pH was determined at 20°C after homogenizing 1 g meat samples in 5 ml of distilled water.

Glucose concentration was determined in neutralized perchloric acid extracts by the glucose oxidase-peroxide method.

A fluorescent *Pseudomonas sp.* isolated from spoilt mutton was used to inoculate meat samples.

Results and Discussion

Individual muscles from beef striploins were examined for pH and glucose content. There were wide variations in the glucose concentration at any pH value, but the average glucose content decreased with increasing pH (Table 1). Glucose was absent from all muscles above pH 6.4, but could be absent in muscles with a pH as low as 6.0. Of the three muscles present the L. costarum always had the highest pH (Table 2).

Table I

pH and glucose content of individual muscles from suspected DFD beef striploins

Ultimate pH	No. of muscles	Glucose concentration (µg/g wet wt) range	average
5.40 - 5.49	5	90 - 202	118
5.50 - 5.59	8	73 - 108	82
5.60 - 5.69	3	33 - 106	70
5.70 - 5.79	3	25 - 86	58
5.80 - 5.89	10	10 - 148	59
5.90 - 5.99	12	8 - 66	33
6.00 - 6.09	5	0 - 33	13
6.10 - 6.19	2	0 - 12	6
6.20 - 6.29	3	3 - 29	15
6.30 - 6.39	4	0 - 10	5
6.40 - 6.70	9	0	0

Table II

Average pH and glucose content of the different muscles present in eighteen suspected DFD striploins

	Average pH	Average glucose concentration (µg/g wet wt)
Longissimus dorsi	5.67	62
Multifidus dorsi	5.97	37
Longissimus costarum	6.16	22

Slices of meat of pH 6.3 and devoid of glucose were treated with L-lactic acid solution to reduce the pH to 5.6, or with glucose solution to give a final glucose concentration of about 100 µg/g wet weight. These meat slices and controls of high pH (pH 6.3, no glucose) and intermediate pH meat (pH 5.85, glucose 112 µg/g wet weight) were inoculated with the fluorescent *Pseudomonas*, and incubated at 10°C under humid, aerobic conditions. The length of the lag phase increased with decreasing pH, but there appeared to be no difference in growth rates on treated and untreated slices of meat of initial high pH and on control slices of intermediate pH meat. Spoilage odours could be detected in the meat samples devoid of glucose after two days, but were not apparent until the fourth day in samples where glucose was present (Figure 1). The average glucose concentrations in beef, mutton and pork are about 100, 400 and 800 µg/g wet weight respectively. Since previous work on bacterial spoilage had been carried out on mutton only, samples of mutton devoid of glucose were inoculated with the *Pseudomonas* and examined for the development of increased ammonia concentrations at the inoculated surface. Ammonia formation at the inoculated surface was detectable when the bacterial cell density exceeded $10^6/cm^2$, whereas in normal mutton a cell density in excess of $10^8/cm^2$ must be attained before release of ammonia is observed (Gill, 1976).

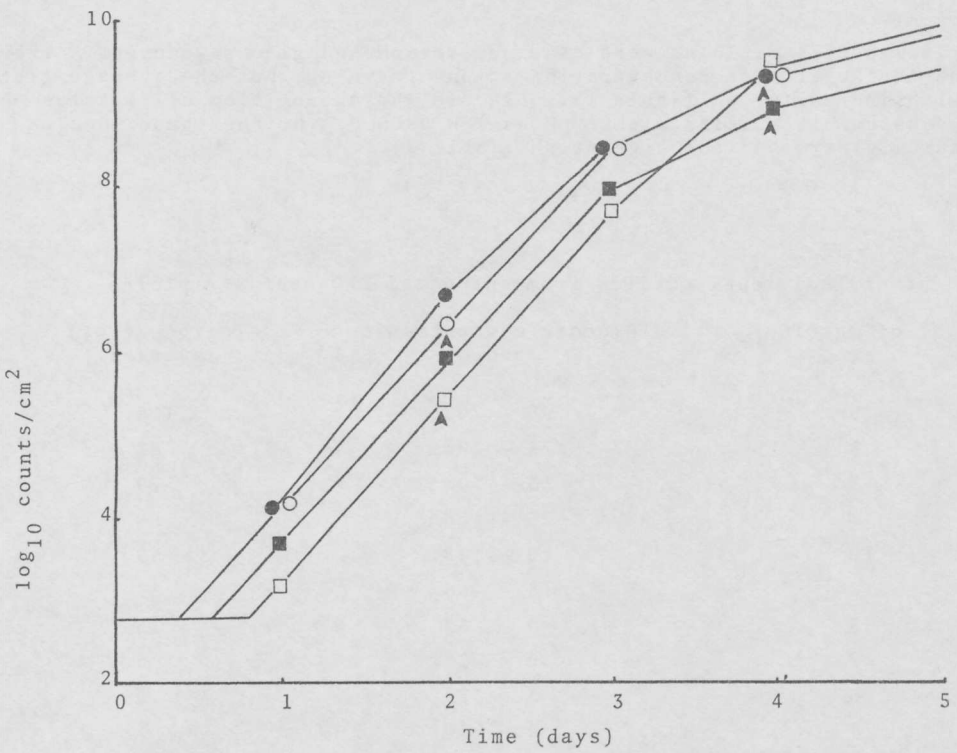

Fig. 1 Growth of a fluorescent *Pseudomonas* at 10°C on meat slices of differing pH and glucose contents (○) pH 6.3, glucose absent; (●) pH 6.3, glucose 100 µg/g wet wt; (□) pH 5.6, glucose absent; (■) pH 5.85, glucose 112 µg/g wet wt. (▲) indicates spoilage odours detected.

The pH of meat is usually considered to be the most important indicator of the DFD condition (Scheper, 1976). However, the critical factor for keeping quality appears to be the depletion of glucose, and glucose content is highly variable. Analysis for glucose in those muscles most susceptible to glucose exhaustion would seem to be the most reliable guide to the keeping quality of suspected DFD meat.

References

Gill, C.O., 1976. Substrate limitation of bacterial growth at meat surfaces. J. Appl. Bact. 41, 401-410.

Gill, C.O. & Newton, K.G., 1977. The development of aerobic spoilage floras on meat stored at chill temperatures. J. Appl. Bact. 43, 189-195.

Scheper, J., 1976. DFD-meat and how to recognize it. Die Fleischwirtschaft 56, 970-973.