

EFFECT OF PSYCHROTOLERANT BACTERIA ON MINCED BEEF QUALITY

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Sterile minced beef was used to observe the effect of two psychrotolerant bacteria on quality during a 27 day storage period at 7°C. The bacteria, a non-pigmented pseudomonas and a pseudomonas fluorescens species, had previously been isolated and purified from spoiled beef.

The inoculated samples were assessed for quality using chemical and bacteriological techniques. pH of the inoculated samples increased with bacterial numbers. Significant proteolytic activity was evident when the counts reached $1.0 \times 10^9/g$. Increases in total volatile nitrogen did not occur until late in the storage period and when off-flavours were evident.

LES EFFETS DE LA BACTÉRIE PSYCHRORESISTENTE SUR LA QUALITÉ DE LA VIANDE DE BOEUF HACHÉE

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On a étudié les effets de deux bactéries psychrorésistantes sur la qualité de la viande de boeuf hachée stérile pendant 27 jours de stockage à 7°C. D'abord on avait isolé les bactéries, un pseudomonas non-pigmenté et un pseudomonas d'un type fluorescens, due boeuf abimé et alors elles ont été purifiées.

En se servant des techniques chimiques et bactériologiques on a mesuré la qualité des échantillons injectés; leur pH avait augmenté selon l'augmentation des nombres bactériens. Une activité proteolytique signifiante était évidente quand les nombres avaient atteint $1.0 \times 10^9/g$. Les augmentations dans le total nitrogen volatil ne sont pas survenues que tard dans la période de stockage et quand les mauvaises flaveurs se présentaient.

WIRKUNG VON PSYCHROTOLERANTEN BAKTERIEN AUF HACKFLEISCHQUALITÄT

Steriles Hackfleisch wurde verwendet, um die Wirkung zweier psychrotoleranter Bakterien auf seine Qualität während einer 27-tägigen Lagerungsperiode bei 7°C beobachten zu können. Die Bakterien, bei denen es sich einmal um ein nichtpigmentiertes, *Pseudomonas*, zum anderen um ein *Pseudomonas fluorescens* handelt, waren vorher von verdorbenem Rindfleisch isoliert und gereinigt worden.

Die geimpften Proben wurden durch chemische und bakteriologische Verfahren auf ihre Qualität hin geprüft. Der pH-Wert der geimpften Proben nahm mit zunehmender Anzahl der Bakterien zu. War die Anzahl auf 1.0×10^9 /g gestiegen, so war eine signifikante proteolytische Wirkung nachweisbar. Erst zu einem späten Zeitpunkt in der Lagerungsperiode, als üble Gerüche wahrzunehmen waren, traten Zunahmen des gesamten volatilen Stickstoffes ein.

ДЕЙСТВИЕ ПСИХОТЕРПИМЫХ БАКТЕРИИ НА КАЧЕСТВО РУБЛЕНОЙ ГОВЯДИНЫ
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СТЕРИЛЬНАЯ РУБЛЕНАЯ ГОВЯДИНА ИСПОЛЬЗОВАЛАСЬ ЧТОБЫ ЗАМЕЧАТЬ ДЕЙСТВИЕ ДВУХ ПСИХОТЕРПИСЫХ БАКТЕРИИ НА КАЧЕСТВО В ТЕЧЕНИЕ 27 ДНЕЙ ХРАНЕНИЯ ПРИ 7°C. ПРЕДВАРИТЕЛЬНО БАКТЕРИИ, НЕПИГМЕНТИРОВАННОЙ *Pseudomonas* И ВИД *Pseudomonas fluorescens*, ИЗОЛИРОВАЛИСЬ И ОЧИСТИЛИСЬ ОТ ПОРЧЕННОЙ ГОВЯДИНЫ.

КАЧЕСТВО ИНОКУЛИРОВАННЫХ ОБРАЗЦОВ ОПРЕДЕЛИЛОСЬ СПОСОБОМ ХИМИЧЕСКИХ И БАКТЕРИОЛИЧЕСКИХ ТЕХНИК. pH ИНОКУЛИРОВАННЫХ ОБРАЗЦОВ УВЕЛИЧИВАЛОСЬ ПО БАКТЕРИАЛЬНЫМИ НОМЕРАМИ. ЯВИТСЯ ЗНАМЕНАТЕЛЬНОЕ ПРОТЕОЛИТИЧЕСКОЕ ДЕЙСТВИЕ КОГДА СЧЁТЫ ДОСТИГАЮТ 1.0×10^9 /г. УВЕЛИЧЕНИЯ ОБЩЕГО ЛЕТУЧЕГО АЗОТА НЕ СЛУЧИЛИСЬ ДО ПОЗДНОЙ ЧАСТИ ПЕРИОДА ХРАНЕНИЯ И КОГДА ЯВИТСЯ НЕПРИЯТНЫЙ ВКУС.

EFFECT OF PSYCHROTOLERANT BACTERIA ON MINCED BEEF QUALITY

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INTRODUCTION

The micro-flora of fresh meat is heterogeneous and is the result of external contamination during the killing, evisceration and butchering operations. The *Pseudomonas* and *Achromobacter* type microorganisms dominate the flora during cold storage and the onset of spoilage. (Jay 1967). Spoilage is essentially caused by production of undesirable microbial metabolites produced by the growing flora and is not the result of bacterial numbers *per se*. Bacterial growth takes place at the expense of the low molecular weight constituents such as free amino acids, nucleotides, etc., and in the absence of significant proteolysis (Jay 1966). However, there is evidence that protein breakdown occurs with some bacteria. Hydrolysis of sarcoplasmic proteins was reported by Hasegawa *et al.*, (1970). Also, Tarrant *et al.*, (1971) found that *Pseudomonas fragi* caused degradation of the myofibrillar fraction of pig muscle.

The reason for some variations in results reported in the literature would seem to be due to differences in the predominant types of organisms naturally present or inoculated into the meat. In this study, the organisms used were isolated from spoiled beef, reinoculated into fresh sterile beef muscle, and their effects evaluated during 27 days of storage at 7°C. A simple and inexpensive method for obtaining sterile muscle tissue from a beef carcass was developed.

MATERIALS AND METHODSSterile Beef Samples

Slaughtering and evisceration of animals was carried out in the usual manner on an automated line in a local abattoir. Carcasses were chilled overnight at 2°C to 5°C and then boned out at 10°C. The boner wore sterile gloves, and used a sterile knife to remove the strip loin (5 to 6kg) from the carcass which was then placed in a sterile covered container and transported to the laboratory. The samples were prepared under controlled bacteriological conditions. Air was filter-sterilized and blown over the working table and grinder towards the operator, by an air-sterilizing unit supplied by Microfilm Ltd., England. The strip-loin, with skin-side flat was placed on sterile aluminium foil and incisions made longitudinally in the tissue with a sterile knife. A second sterile knife was then used to cut approximately 2cm thick slices along the loin. Samples from the interior were then removed aseptically and ground through a sterile grinder using a 4mm grinding plate. The ground meat was collected in a sterile container. Control samples were then prepared for each sampling period by aseptically transferring some ground tissue to sterile 25ml screw-cap bottles with the caps only partly sealed to maintain aerobic conditions. Other portions of the aseptically procured tissue were inoculated with the test bacteria and again transferred as above. One sample was used for each sampling period.

Meat Spoilage Microorganisms

A non-pigmented *pseudomonas* and a *pseudomonas fluorescens* species were isolated from a portion of beef which was allowed to spoil at 7°C. Prior to inoculation the purified cultures were transferred three times in nutrient broth to obtain optimum growth. The ground meat was inoculated with a culture in log phase and transferred to 25ml screw-cap bottles and stored at 7°C.

Evaluation

Serial dilutions of the controls and inoculated samples were prepared and plated out on Plate Count Agar using a spread plate technique. The plates were incubated at 21°C for 3-5 days. A Radiometer pH meter 26 was used for pH measurement. Total volatile nitrogen was determined by the macrodistillation procedure of Lucke & Geidel (1935) as modified by Pearson (1968a). Proteolytic activity was carried out as described by Tarrant *et al.* (1971). using a 2% casein solution as substrate.

RESULTS AND DISCUSSION

No microbial growth was observed in the control samples of tissue at any stage during the storage period (Fig. 1). The sample inoculated with the species of non-pigmented *Pseudomonas* showed the most vigorous growth. Although the initial counts varied, growth in all cases reached a peak after approximately 10 days of storage. At this point the meat was deemed to be spoiled by visual and smell observations.

The pH of meat has been used to assess the keeping quality of meat in some European countries and Pearson (1968b) claimed that a cut-off value of 6.0-6.1 could be used in conjunction with other criteria to assess acceptability of minced meat. The samples inoculated with the *Pseudomonas fluorescens* species showed an increase in pH with storage time, but not to the same extent as found for the samples inoculated with the non-pigmented *Pseudomonad*. The counts were 10^6 /g and 10^8 /g for the *Pseudomonas fluorescens* and non-pigmented *pseudomonas* species, respectively, when the cut-off value of 6.0 proposed by Pearson (1968b) was reached. Similar species differences have been reported by Borton *et al.*, (1970). The differences in the rate of pH change with bacterial growth is perhaps a reflection of microbial de-aminating ability.

Pearson (1968a) reported that the total volatile nitrogen value at the "just spoilage stage" was 24mgN/100g tissue. The cut-off value was reached in 8 days with the non-pigmented *Pseudomonad* when the bacterial load was 10^9 /g (Fig. 2). However, in the case of the *Ps. fluorescens* species, the cut-off value was not reached until the 15 day when the growth was in the stationery phase at 10^{10} /g and the meat deemed spoiled by visual observations. Autolytic production of volatile nitrogenous substances in the sterile controls was negligible.

Considerable proteolysis occurred within 6 days with both organisms when the counts were about 10^8 /g (Fig.3). This rapid increase in extracellular proteolytic activity was associated with the onset of spoilage. These results are similar to those reported by Tarrant *et al.* (1971) using *Ps. fragi*. The extract from the aseptic controls showed no increase in activity throughout the study period. The present results would suggest that this test is more sensitive than either pH or total volatile nitrogen measurement as an index of minced meat quality.

REFERENCES

1. Borton, R.J., Bratzler, L.J. & Price, J.F. (1970). *J. Food Sci.* 35, 779.
2. Hasegawa, T., Pearson, A.M., Price, J.F., Rompton, J.H. & Lechowick, R.V. (1970). *J. Fd. Sci.* 35, 720.
3. Jay, J.M. (1966). In "*The Physiology and Biochemistry of Muscle as a Food.*" Eds. E.J. Briskey, R.G. Cassens, and J.C. Trautman. p. 387-402. University of Wisconsin Press, Madison.
4. Lucke, F. & Geidel, W. (1935), *Z. Unters. Lebensmittel* 70, 441.
5. Pearson, D. (1968a). *J. Sci. Fd. Agric.* 19, 366.
6. Pearson, D. (1968b). *J. Sci. Fd. Agric.* 19, 556.
7. Tarrant, P.J.V., Pearson, A.M., Price, J.F. & Lechowick, R.V. (1971). *Appl. Micro.* 22, 224.

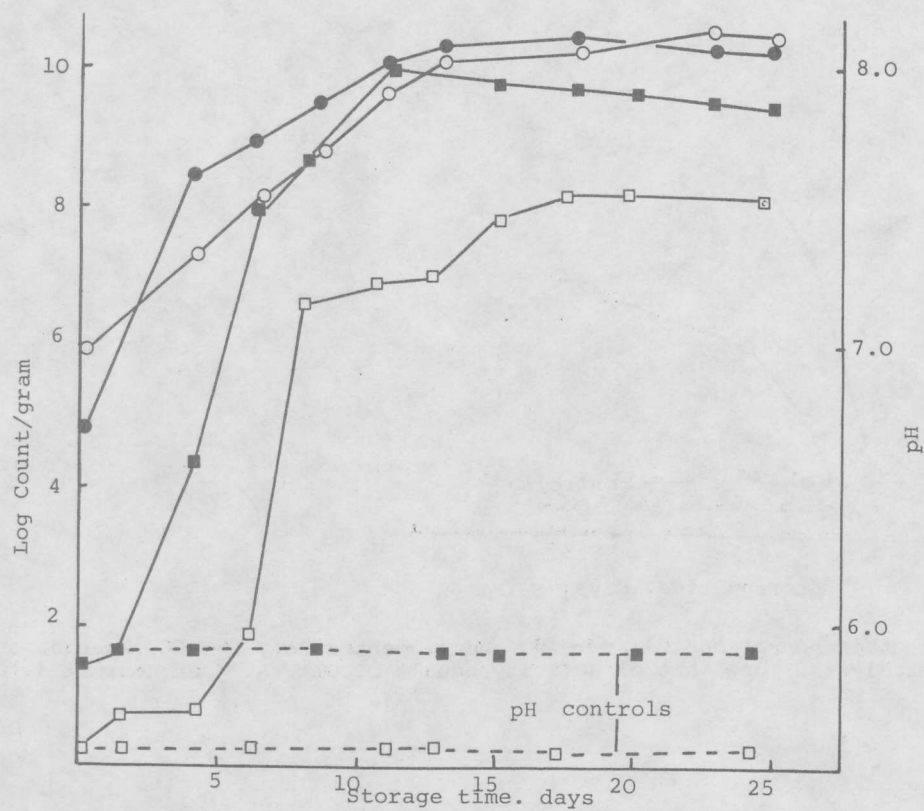


Figure 1. Changes in bacterial numbers during storage at 7°C, ●—● non-pigmented Ps.; ○—○ pigmented Ps.; and their effect on pH; ■—■ non-pigmented Ps.; □—□ pigmented Ps.

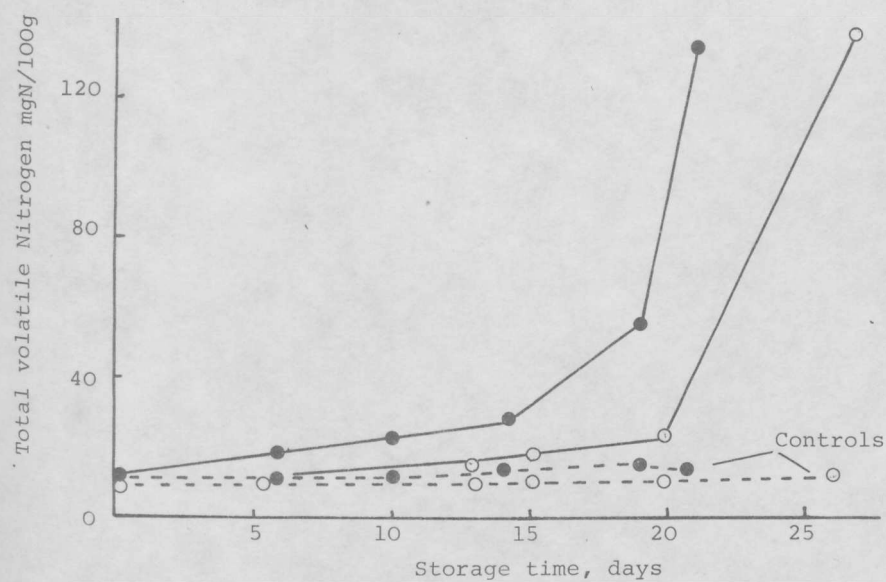


Figure 2. Effect of non-pigmented, ●—● and pigmented Ps. ○—○ species on total volatile nitrogen during storage at 7°C.

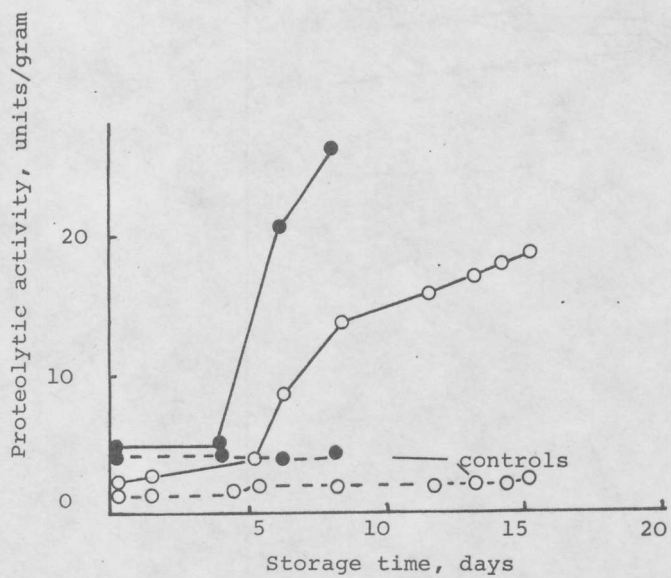


Figure 3. Effect of non-pigmented, ●—●, and pigmented Ps., ○—○, species on proteolysis. One unit of activity equals $0.001 A_{280}$ per hour at 37°C .