Asian Fisheries Science 9(1996): 61-68.
Asian Fisheries Society, Manila, Philippines
https://doi.org/10.33997/j.afs.1996.9.1.006

Triploid Oysters in Australia, VIII. Sensory Evaluation of Sydney Rock Oysters *Saccostrea commercialis*

S. KORAC, J.A. NELL[1] and J. PRESCOTT

CSIRO, Division of Food Science and Technology
Sensory Research Centre
North Ryde, NSW 2113 Australia

[1] *NSW Fisheries*
Port Stephens Research Centre
Taylors Beach, NSW 2316 Australia

Abstract

Sensory evaluations of Sydney rock oysters were undertaken as part of a study of the performance of triploid oysters in New South Wales (NSW), Australia. Diploid and triploid oysters, matched for size, were harvested and depurated from intertidal sites at Tilligerry Creek and North Arm Cove in Port Stephens, NSW; and subsequent sensory evaluations were conducted at the Sensory Research Centre of the Commonwealth Scientific and Industrial Research Organization (CSIRO), in October 1991 (session 1, 20 months), January 1992 (session 2, 23 months) and November 1992 (session 3, 33 months).

The sensory evaluation revealed that for sessions 2 and 3, triploid and diploid Sydney rock oysters were equally acceptable. Although the triploid oyster was less acceptable in texture and overall acceptability at session 1, the size (26 g) and meat condition (condition index < 8) of both oysters were below market acceptability. At session 3, the oysters received a high acceptability score (mean rating > 60), had good meat condition (CI > 9) and were of market size (oyster weight > 40 g). The faster growth and better meat condition of triploid Sydney rock oysters, as shown by previous studies, coupled with the high sensory scores obtained for marketable oysters in this study, indicate that triploids have excellent farming and marketing potential. They are a suitable alternative to diploids as a winter crop for NSW oyster farmers.

Introduction

Sydney rock oysters *Saccostrea commercialis* generally spawn in the summer and autumn and, as a result, are in poor condition during winter and spring, making them difficult to market for up to 6 months of the year (Nell 1993). It was thought that because triploid oysters have reduced gonad development (Beaumont and Fairbrother 1991), triploid Sydney rock oysters would be a good winter crop for oyster farmers (Nell et al. 1994).

The effects of triploidy on seasonal changes in meat condition in Sydney rock oysters and growth rates were assessed in a parallel study by Nell et al. (1994). Triploid Sydney rock oysters were on average 41% heavier than their diploid siblings after 2.5 years of growth (Nell et al. 1994). Triploid oysters also maintained higher dry meat weight and higher condition index (CI) values than their diploid siblings at all sites, during the final 10 months' growth to market size (40-60 g whole weight) (Nell et al. 1994).

G. B. Maguire (unpub. data 1994) showed that there were few significant differences in sensory quality between diploid and triploid Pacific oysters provided to Australian panels. However, Allen and Downing's (1991) study showed that both consumers and "experts" alike preferred the triploid over diploid oysters in the USA. Triploid oysters are therefore likely to be acceptable to consumers.

These findings have major implications for the oyster industry in New South Wales (NSW) as triploid Sydney rock oysters can reach market size 6-18 months faster and maintain better meat condition than diploid oysters (Nell et al. 1994).

In this study, the effects of triploidy on the sensory quality and acceptability of Sydney rock oysters were investigated over time, to determine their marketability as a winter crop. This study was undertaken as part of a research on the performance of triploid oysters on leases in NSW (Nell et al. 1994).

Materials and Methods

Oyster Husbandry

Sensory evaluation of diploid and triploid Sydney rock oysters was undertaken as part of a farming research study conducted by NSW Fisheries (Nell et al. 1994).

Triploidy is produced using chromosome set manipulation. Triploids are sterile as they contain an extra set of maternal chromosomes retained by the egg when treated with chemical or physical agents shortly after fertilization (Allen and Downing 1991).

Diploid and triploid oysters were grown at Tilligerry Creek and North Arm Cove, intertidal sites in Port Stephens (map: Nell 1993). The larvae were set in February 1990 and grown until November 1992. Oysters were collected from Tilligerry Creek for the first and second sensory evaluation, and from North Arm Cove for the third evaluation.

Sampling

Diploid and triploid oysters were harvested during October 1991 (session 1, age 20 months), January 1992 (session 2, age 23 months) and November 1992 (session 3, age 33 months). Samples, matched for size, were depurated for 36 h (Nell et al. 1994), within 2 d of harvesting and evaluated within 3 d of depuration. They were transported by road, out of water, in air-conditioned transport, to the Division of Food Science and Technology, Sydney Laboratory of the Commonwealth Scientific and Industrial Research Organization (CSIRO). The samples were shucked and evaluated on the morning of delivery or immediately the next day. Samples were served raw at a temperature of approximately 10°C.

Weights and Measurements

Whole oyster weight, dry and wet meat weight (Nell et al. 1994) and condition index (CI) (Crosby and Gale 1990) were measured using 24 diploid and 24 triploid oysters for each session. Glycogen was measured using four samples of each oyster for each session by a modified Keppler and Decker (1974) procedure (G.B. Maguire, unpubl. data 1994). These measurements were carried out at the University of Tasmania.

Sensory Evaluation

The sensory evaluation was conducted at the Sensory Research Centre, CSIRO Division of Food Science and Technology, Sydney Laboratory.

A total of 42 adult judges (24 male and 18 female CSIRO staff) evaluated the oysters. Of these judges, 22 attended session 1, and 25 attended sessions 2 and 3. Their ages ranged from 18 to 35 years, with a mean of 27 years. Selection of judges was based on a liking for natural (raw) oysters. Most of the judges had previous experience in the sensory evaluation of food.

The sensory evaluations were conducted in October 1991 (session 1, whole weight 26 g), January 1992 (session 2, whole weight 27 g) and November 1992 (session 3, whole weight 42 g).

Each evaluation consisted of three oysters, scrubbed and freshly shucked, served in the half shell on white plastic disposable plates, with white plastic disposable forks, to judges seated in individual booths.

To reduce sample and panel biases, the samples were presented sequentially, in counter-balanced order, and coded with three digit random numbers, which were changed after each set of 10 panelists. To cleanse their palates, each judge was given a glass of water and instructed to rinse his/her mouth with the water after tasting each oyster sample.

The judges were required to rate their liking for the oysters' sensory attributes - appearance, texture/mouthfeel, flavor - and overall acceptability on a scoresheet. The rating scales were unstructured, 150 mm lines, with the anchor words indicating disliking and liking at opposite ends (See Fig. 1). A separate scoresheet was given with each sample of diploid and triploid oysters. The judges rated their evaluations by placing a vertical mark across each line. These ratings were then digitized to give a potential range of 0-100.

Statistical Analysis

All of the following analyses were conducted and reported at the 5% level of significance ($P<0.05$, Meilgaard et al. 1991).

The weights (whole oyster, dry and wet meat), CI and glycogen measurements were analyzed using one-way analysis of variance (ANOVA).

After each session, the data for each sensory attribute were subjected to

OYSTERS

Name/Taster No. ______________ Date ______________

Age ______ Sex ______ Sample No. ________

1. Appearance (before tasting)

Extremely poor — Extremely good

2. Flavor

Extremely poor — Extremely good

3. Texture/Mouthfeel

Extremely poor — Extremely good

4. Overall acceptability

Not at all acceptable — Extremely acceptable

Fig. 1. Sensory evaluation scoresheet.

two-way ANOVA, with factors for oyster (diploid and triploid) and judge. Judge was a random factor, while oysters (ploidy) was a fixed factor. Separate ANOVAs were carried out on the data for each of the three sessions because different judges were used for each session.

Results

Weights and Measurements

The size and whole oyster weights of diploid and triploid oysters were matched at each of the three sessions so as to remove this variable from the experimental design. The samples were below market size (26-27 g) with poor meat condition (CI of 7.1-7.7) at sessions 1 and 2 (20 and 23 months, respectively). The oysters had reached market size (42 g) with good meat condition (CI of 9.2-9.5) by session 3 (33 months).

The one-way ANOVA (Table 1) showed that there were no significant differences in the weights and measurements (whole oyster, dry and wet meat weights, glycogen and CI) between diploid and triploid oysters, within sessions.

Sensory Evaluation

Examination of the data revealed one judge was an extreme outlier in his assessment of both oysters for session 1 (zero scores). The data were therefore analyzed without this judge.

Two-way ANOVA was used to analyze the results for each session, individually. At session 1, the texture of the diploid oysters were preferred to that of the triploids, and the diploid oysters were also more acceptable overall. There were no significant differences between the diploid and triploid oyster mean ratings (within sessions) for appearance and flavor at session 1 (Fig. 2).

At sessions 2 and 3, the ANOVA showed no significant differences between the means of the two oysters (within sessions) for the four sensory attributes assessed (Fig. 2).

The sensory mean score of oveall acceptability for diploid oysters were 62.2, 54.5 and 64.8 (sessions 1, 2 and 3, respectively) and triploid oysters 51.1, 57.6 and 61.9 (sessions 1, 2 and 3, respectively.)

Table 1. Weights and measurements: sample means (with standard errors) for diploid and triploid Sydney rock oysters at each session. All differences are not significant at the 5% level. All tests used 24 samples of each type of oyster unless otherwise stated.

Measurement	Diploid oyster	Triploid oyster
Session 1 - October 1991 (age of oysters 20 months)		
Glycogen#	11.8 (0.5)	13.0 (0.6)
Condition index	7.1 (0.2)	7.3 (0.2)
Whole oyster weight	26.2 (0.7)	26.8 (0.7)
Dry meat weight	0.62 (0.02)	0.63 (0.02)
Wet meat weight	4.73 (0.21)	4.25 (0.14)
Session 2 - January 1992 (age of oysters 23 months)		
Glycogen#	8.6 (1.0)	9.7 (0.8)
Condition index	7.0 (0.3)	7.7 (0.3)
Whole oyster weight	27.1 (0.8)	27.3 (0.6)
Dry meat weight	0.60 (0.03)	0.65 (0.03)
Wet meat weight	3.64 (0.13)	3.60 (0.13)
Session 3 - November 1991 (age of oysters 20 months)		
Glycogen#	13.7 (0.7)	13.4 (0.4)
Condition index	9.2 (0.4)	9.5 (0.5)
Whole oyster weight	42.3 (0.6)	41.8 (0.8)
Dry meat weight	1.01 (0.05)	1.13 (0.06)
Wet meat weight	5.95 (0.18)	6.19 (0.23)

#(n=4)

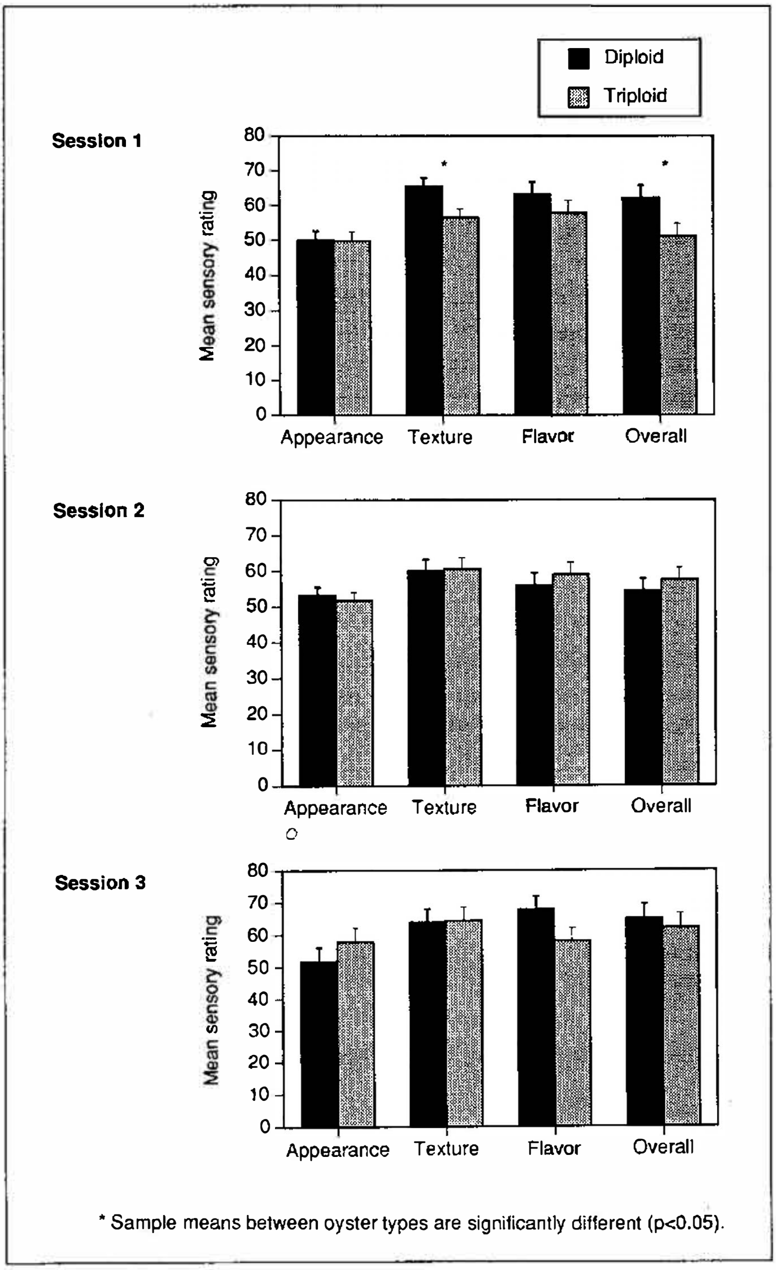

Fig. 2. Sample means (± s.e.m.) for sensory ratings of appearance, texture, flavor and overall acceptability of diploid and triploid Sydney rock oysters, over three sessions.

Discussion

Overall, the mean sensory scores were high when taking into account the phenomenon of central tendency (Meilgaard et al. 1991). This is the tendency of panelists to avoid evaluating products at the extreme ends of the scale (extreme like or extreme dislike). Ratings of 80 or more out of a possible score of 100 are uncommon for sensory panels. Thus, the hedonic mean sensory scores for appearance, texture, flavor and overall, for both oyster types, were acceptable at all three sessions with an increase in overall acceptability from sessions 2 to 3.

The triploid oyster was less acceptable in texture and overall acceptability at session 1 (20 months). However, this may not be of practical importance as both the size (26 g) and meat condition (CI < 8) of the oysters were below market acceptability. Thus, these oysters would not normally be available to consumers in this condition.

No significant differences were found between diploid and triploid oysters, for the four sensory attributes assessed, at the two latter sessions (23 and 33 months, respectively). Both diploid and triploid oysters developed to market size (42 g) with good meat condition (CI > 9.0) by the third session (33 months). The overall acceptability ratings for both oysters also increased from session 2 to 3 (from an average mean of 56 to 63, respectively).

When meat condition of an oyster is poor (CI < 8.0), consumer acceptability of triploids may be less than that for diploids, as was shown in session 1. However, this was not the case at session 2, as meat condition was still poor and both oysters were equally acceptable.

It is unlikely that taste preference was affected by the glycogen content of the meat, as glycogen is rather tasteless (G. B. Maguire, unpubl. data 1994). Neither is it likely that oyster size or age would have had a major effect on taste as gonad development in oysters commences well before one year of age (Roughley 1933).

Althought meat condition influences taste and consumer acceptability of oysters (Nell 1993), and our results also showed an increase in acceptability with increase in meat condition, it seems that flavor and acceptability are determined by a complex mixture of compounds in the oysters (Soliman et al. 1983).

Therefore, the data from this study suggest that triploid Sydney rock oysters are as acceptable as diploid Sydney rock oysters, in terms of sensory attributes, when they are of marketable condition.

Triploid Sydney rock oysters can reach market size (40-60 g whole weight) 6-18 months faster and maintain better meat condition than diploid oysters (Nell et al. 1994). Thus, triploid Sydney rock oysters have the potential to become a valuable winter crop for NSW oyster farmers.

This study confirmed the findings by McBride et al. (1988) that Sydney rock oysters are a highly acceptable seafood. The faster growth and better meat condition of triploid Sydney rock oysters (Nell et al. 1994), with the high sensory scores obtained for marketable triploids in this study, show that triploids have excellent farming and marketing potential.

Acknowledgments

We thank the following for their contribution: NSW Fisheries, for providing the oysters; University of Tasmania, for conducting the weights and measurements of the oysters; Maree O'Sullivan, CSIRO Biometrics Unit, for providing statistical advice; and Dick Stevenson, CSIRO Division of Food Science and Technology, John Best, CSIRO Biometrics Unit, and Greg Maguire, University of Tasmania, for their comments on the manuscript.

References

Allen, S.K., Jr. and S.L. Downing. 1991. Consumer and "experts" alike prefer the taste of sterile triploid over gravid diploid Pacific oysters (*Crassostrea gigas*). Journal of Shellfish Research 10: 19-22.

Beaumont, A.R. and J.E. Fairbrother. 1991. Ploidy manipulation in molluscan shellfish: a review. Journal of Shellfish Research 10: 1-18.

Crosby, M.P. and L.D. Gale. 1990. A review and evaluation of bivalve condition index methodologies with a suggested standard method. Journal of Shellfish Research 9: 233-237.

Keppler, D. and K. Decker. 1974. Glycogen determination with amyloglucosidase. In: Methods of enzymatic analysis, Vol. 3 (ed. H.U. Bergmeyer), pp. 1127-1131. Academic Press, New York.

McBride, R.L., J.A. Nell and K.M. Easton. 1988. Acceptability of the Sydney rock and Pacific oyster. Food Technology of Australia 40: 287-290.

Meilgaard, M.M., G.V. Civille and B.T. Carr. 1991. Sensory evaluation techniques, 2nd edition, CRC Press Inc., Boca Raton. 354 pp.

Nell, J.A., E. Cox, I.R. Smith and G.B. Maguire. 1994. Studies on triploid oysters in Australia. I. The farming potential of triploid Sydney rock oysters *Saccostrea commercialis* (Iredale and Roughley). Aquaculture 126: 243-255.

Nell, J.A. 1993. Farming the Sydney rock oyster (*Saccostrea commercialis*) in Australia. Reviews in Fisheries Science 1: 97-120.

Roughley, T.C. 1933. The life history of the Australian oyster (*Ostrea commercialis*). Proceedings of the Linnean Society of New South Wales. Sydney 58: 279-333.

Soliman, M.M., A.A. Fahmy, A.A.E. Sawy and F. Osman. 1983. Effect of salting treatment on the flavour of oyster, donax and sea urchin. Agricultural and Biological Chemistry 47: 147-154.

Manuscript received 3 July 1995; accepted 28 February 1996.

Requests for reprints should be addressed to J. Prescott.