Food Chemistry **13** (1984) 277–284

Quality Assessment of Laminated Fillet Blocks from Blue Whiting (*Micromesistius poutassou*)

Oladapo A. Afolabi, Olusegun L. Oke

Department of Chemistry, University of Ife, Ile-Ife, Nigeria

&

Kevin J. Whittle

Torry Research Station, 135 Abbey Road, Aberdeen, Great Britain

(Received: 1 June, 1983)

ABSTRACT

Laminated fillet blocks made from blue whiting (Micromesistius poutassou) *caught in February and April were assessed for quality. The total protein nitrogen value in February-caught fish was greater than the April-caught fish. The bone content, water content and pH values were consistently lower in the February fish than the April fish. Measurement of the acceptability of deep fried, breaded fingers made from the fish and compared with cod fingers produced from fish caught at the same time of year showed a consistent difference between the cod and blue whiting. In addition, the fish fingers from fish caught in February scored consistently higher than those caught in April. The implications of the findings are discussed.*

INTRODUCTION

Each year, blue whiting begin to congregate in dense shoals at 300–600 m on the continental shelf west of the British Isles and Eire in February and spawn later in March and April. Catch rates exceeding 50 tonnes/h are possible. Concentrations can be located on the Faroe shelf in autumn and winter when the fish can also be caught in dispersed fishing in the

Food Chemistry 0308-8146/84/$03·00

Norwegian Sea. Estimates of the size of the spawning stock have varied from 5 to 15 million tonnes and with resource it is thought possible to sustain an annual catch of about 1 million tonnes.

Despite its small average size and weight (30 cm, 180 g), there has been some interest in the UK in the potential for exploiting this seasonal fishery for human consumption. However, compared with other gadoids, blue whiting show a much greater degree of seasonal variability in basic biological and chemical properties during the spawning season which can affect some of the factors important in processing (Whittle *et al.*, 1980).

It was not absolutely clear, when the research described below was initiated, in what variety of forms blue whiting would be frozen or stored in commercial practice. Whole ungutted fish blocks, regular blocks of skinless fillets (laminated), fillet portions, fish fingers and mince blocks all seem likely forms in which blue whiting might be frozen and stored commercially. The most common intermediate product in the manufacture of frozen white fish products is the laminated fillet block.

The purpose of this study was to assess the quality of laminated blocks made from fillets cut and skinned by the experimental Baader 121 filleting machine.

MATERIALS AND METHODS

Laminated block production

Pre-determined weights of skinless fillets (7·4 kg) were packed by hand into a rectangular metal frame containing a waxed card carton. The packed frames or molds were then frozen in a horizontal plate freezer and the rectangular frozen blocks protected by the waxed carton were ejected for storage at −30 °C until required.

Sample preparation

Laminated blocks were cut by bandsaw into suitable portions for the determination of bone content, total protein nitrogen, pH and water content. The cut portions were quickly wrapped in aluminium foil and kept frozen at −30 °C until required for assessment.

Bone content determination: About 1 kg of frozen fillet block was weighed quickly and thawed at 1 °C. It was chopped finely using scissors, about 1·5 litres of hot water were added to the mince in a beaker (capacity 3 litres) and the mixture was stirred vigorously. Papain powder (1–2 g) was added and the temperature of the mix was maintained at 60 °C. When the flesh had dispersed and the solids were in the form of a flocculent suspension (about 45 min after the addition of enzyme) the bones were allowed to settle for 5 min and the suspension was decanted carefully until 100–150 ml was left. To the suspension, 2 g of NaOH and 20 ml of 0·1 % Alizarin S solution were added and the mixture was allowed to stand for 10 min for the bones to take up the stain. The solution and residue were decanted through a sieve with 250 μm holes. The residue on the sieve was washed with a gentle stream of water to separate the bone particles, which are dyed a pinkish-lilac color, from any remaining proteinaceous matter. The bones were air dried for 24 h, weighed and separated into the different size classes by hand picking.

Total protein nitrogen determination

The portion for protein determination was thawed at room temperature and chopped up, and to 0·5 g of mince, in a 15 ml centrifuge tube, 15 % trichloroacetic acid (TCA) (v/v) was added, mixed and centrifuged at 2000 *g* for 30 min. The supernatant was discarded, more 15 % TCA was added and centrifuged at 2000 *g* for a further 30 min and the supernatant was discarded. The total protein nitrogen of the precipitate was determined by the Kjeldahl method described by Eastoe & Courts (1963).

Water content determination

The portions for analysis in quadruplicate were transferred from the cold store (−30 °C) to −10 °C and quickly weighed. The water contents were calculated from the weight loss after the samples had been heated in an open vessel at 100 °C for 1 week.

pH determination

Portions were thawed at room temperature (20 °C) and pH was measured after homogenising 10 g of sample for 15 s with 20 ml of water in an Ultra-Turrax homogeniser using a Corning pH meter.

TABLE 1
Typical Hedonic Assessment Sheet

In this experiment we are interested in assessing the acceptability of some fish fingers. After tasting each sample, select from the list of 'like' and 'dislike' descriptions, numbers which you think fit your impression of each sample in terms of overall acceptability.

9 Like extremely
8 Like very much
7 Like moderately
6 Like slightly
5 Neither like nor dislike
4 Dislike slightly
3 Dislike moderately
2 Dislike very much
1 Dislike extremely

Assessment by taste panel

Acceptability was evaluated at each tasting session by different panels of 42 staff from Torry Research Station from a pool of 110 consisting mainly of persons not trained formally in sensory assessment. The panel attended in groups of six and five; randomly coded samples were presented to each member for assessment. Fish fingers made from blue whiting (stored at −15 °C) and cod (stored at −30 °C) were used in this assessment. The cod products were included to provide points of reference for evaluation of the results. The assessors described the 'overall acceptability' of the samples using a 9-point hedonic scale (Peryam & Pilgrim, 1957) (Table 1). Since it cannot be assumed that the hedonic scale is linear or that the data are distributed normally, the median was used as a measure of the central tendency of the scores for each sample. The median was calculated as a point value assuming a continuous distribution.

RESULTS

The results are summarised in Table 2. Mean water content in the laminated block rose from a 'normal' value of about 80 % in February in the good biological condition pre-spawning fish to reach about 84 % in April at the peak of spawning in the spent and poor condition fish. A

TABLE 2
Seasonal Variation of pH, Water Content and Bone Content of Laminated Blocks Made from the Baader 121 Cut Fillet. Values are Means of Five Replicates for Bones, Ten for pH, Twenty-four for Water and Eighteen for Protein. Values in Parentheses are Standard Deviations of Means

	pH	$H_2O\%$	*gN/100 g fish*	*g Bone/kg wet fish*
Fish caught in February	6·74	80·67	2·86	346·3
(fillet block)	(0·04)	(0·02)	(0·44)	(136·9)
Fillet from fish caught in	6·78	80·70		
February	(0·10)	(0·84)		
Fish caught in April	6·86	83·90	2·26	572·9
(fillet block)	(0·03)	(0·01)	(0·33)	(62·1)
Fillet from fish caught in	6·80	82·40		
April	(0·16)	(0·44)		
Fillet block from cod made	6·58	80·40	2·35	240·5
at Torry Research Station	(0·08)	(0·12)	(0·11)	(20·5)
A commercial fillet block	6·94	80·60	1·98	63·0
from cod	(0·17)	(0·36)	(0·14)	(46·7)

similar pattern was observed for pH which rose from 6·74 in February to a value of 6·86 in April.

The bones obtained from the blue whiting blocks ranged from vertebral-type to pin-bone type. Mean bone content of the laminated block rose from 346 mg/kg wet weight in February fish to 573 mg/kg wet weight in April fish. The bones were in the distribution range of thickness:

Small size—0·1–0·35 mm
Medium size—0·36–0·50 mm
Large size— >0·50 mm.

It appears that the large size bones occur in greater proportion in the good condition fish (Table 3). The bone content was compared with a cod laminated block prepared commercially. The blue whiting laminated block (Table 2) had a higher bone content because no effort was made to remove the pin-bones in the blue whiting in this work. Previous work (Whittle *et al.*, 1980) had indicated that the fine, small pin-bones were not detected easily in products.

The protein nitrogen content of the laminated blocks appeared to show a seasonal pattern in which the value for February-caught fish is greater than the April fish.

TABLE 3

Seasonal Variation of Bone Size Distribution in Laminated Block Made from Blue Whiting Fillets using Baader 121 Filleting Machine. Values in Parentheses are Standard Errors of the Mean

	Bone size (% total bone content)		
	Small (0·1–0·35 mm)	Medium (0·36–0·50 mm)	Large (>0·50 mm)
February-caught fish	69·95	15·27	14·78
	(4·64)	(3·45)	(3·21)
April-caught fish	82·64	7·02	10·34
	(3·29)	(1·11)	(2·67)

Table 4 summarises the acceptability assessments of fish fingers prepared from blue whiting blocks produced from fish caught in February and April and compares them with the reference products of cod. There is considerable scatter, which is to be expected of sensory panel data of this type, but differences greater than 0·7 hedonic score units are significant. Clearly, while the blue whiting tend to score lower than the cod at each seasonal point and the April samples show the consistently lower values in each species, the April blue whiting sample has significantly lower acceptability than the April cod sample ($P < 0{\cdot}01$) (Table 4).

TABLE 4

Median Hedonic Scores of Acceptability of Fish Fingers Prepared from Blue Whiting or Cod Laminated Blocks Caught in February or April

Fish type	*Median hedonic scores*
February-caught blue whiting	6·83
April-caught blue whiting	6·20
February-caught cod	7·10
April-caught cod	6·50

DISCUSSION

The results suggest that the loss of biological condition of blue whiting on spawning results in increased bone content in the products. This can be related to the decrease in the overall size of fillets produced from fish of equal length which have just spawned. This results in more fillets per kilogram of block and therefore increased bone content per kilogram block.

In the spawning fish the bone size distribution tends to be related to the shape of the fish, which varies with season (Whittle *et al.*, 1980). The setting of the cutting knife of the Baader 121 was not changed (Fig. 1) in these studies and this is reflected in the bone distribution of the laminated block. The vertebral bones tend to be cut with the fillet in good condition fish. In a previous study (Whittle *et al.*, 1980), it was found that the setting of the knife was related to fillet yield in the seasonal samples; the poor condition fish yield less.

On visual inspection, the overall color of the blocks from April fish appeared lighter and whiter than the February samples. This whiter appearance of samples of April-caught fish corresponds with more depleted fish and higher water content. Possible changes in pigmentation of the dark muscle which may contribute to the overall color appearance were not measured but the whitening effect could also have been due to a

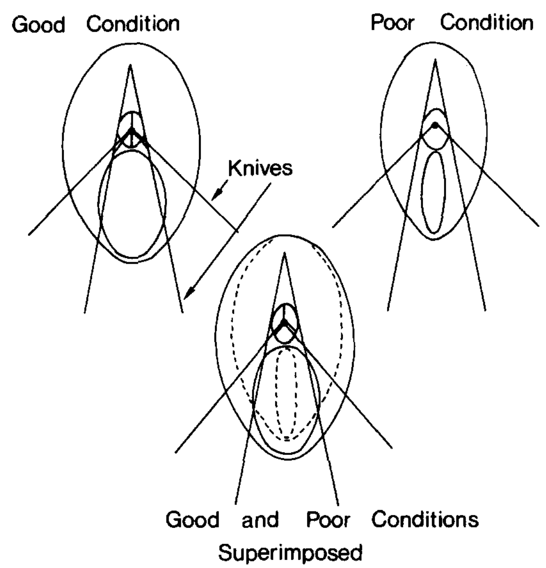

Fig. 1. The change in sectional shape of good and poor condition blue whiting. A diagrammatic cross-sectional area representation of the gross composition by weight of fillet and total gut from blue whiting in good and poor condition. The indicated position of the setting of the cutting knives of the Baader 121 shows how the efficiency of machine filleting is affected by shape.

change in the reflectance properties of the fillet as a result of the increase in muscle water content.

The water content and pH of the laminated blocks remained close to the values measured on the fish before processing (Table 2), so that the real seasonal differences were not distorted by processing.

The decreased protein nitrogen content of the laminated blocks in the April fish reflects the seasonal variation of the water content.

The acceptability of the products from both blue whiting and cod was reduced by the use of fish caught in spring in the spawning or spent condition, confirming earlier findings with a trained sensory panel (Whittle *et al.*, 1980).

In conclusion, the practical implication of the finding in this study is that it appears that spawning fish gives a better color of laminated block. However, the increased bone content, the need for more fish to be processed for the equivalent weight of fish block and the sensory panel's preference for the February-caught fish are all factors which tend to mitigate against the April-caught fish and suggest that the good condition fish are preferred for fillet products.

REFERENCES

Eastoe, J. E. & Courts, A. (1963). In: *Practical analytical methods for connective tissue proteins*, E. and F. N. Spon Ltd, London, p. 39.

Peryam, D. R. & Pilgrim, J. R. (1975). In: *The methodology of sensory testing*, Proc. IFT Symposium, Pittsburg.

Whittle, K. J., Robertson, I. & McDonald, I. (1980). Seasonal variability in blue whiting (*M. poutassou*) and its influence on processing. In: *Advances in fish science and technology* (Connell, J. J. (Ed.)), Fishing News (Books) Ltd, Surrey, England. pp. 378–87.