

Technical note: Chemical and sensory assessments in ripened anchovies

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Introduction

Salting is a traditional process for the preservation of many foods including seafoods. Anchovies, as preserved, are a heavily salted product made by mixing small, somewhat oily fish, typically *Engraulis* species, with salt and allowing the product to mature over several months (Filsinger *et al.*, 1982; Kemp, 1973). The final product has a characteristic combination of appearance, odour, flavour and texture although the reactions that produce these characteristic sensory properties are not well known.

Filsinger *et al.* (1982) have described a scale for the sensory assessment of the ripening process and related a non-sensory test, the Total Ester Index (TEI), to ripening time and sensory rating. This paper describes a sensory scale for the evaluation of the quality of ripened anchovies and presents data on the TEI and water activity of ripened products.

Keywords

Chemical assessment, fish technology, salted anchovies, sensory quality, water activity.

Materials and methods

Preparation of ripened, salted anchovies

Anchovies (*Engraulis anchoita*) were caught in the south-eastern Atlantic Ocean on the Argentinian Platform, approximately 37.4 to 38.8°S, during the Southern hemisphere spring when the fish arrive for spawning. Their weights ranged from 25–33 g/fish.

The salted products were prepared under commercial conditions. Immediately on receipt at the factory the anchovies were immersed in saturated brine and held in the brine for 1–2 days before processing. The fish were headed and partially gutted (nobbed) by hand, washed in brine and then packed in salt in barrels or concrete vats. A layer of salt was first put in the container then a layer of fish, and so on until the container was filled with alternate layers of salt and fish finishing with a layer of salt. A loose-fitting lid was put on top of the mass and weighted with stones or concrete blocks to compress the solids and expel air. During the ripening process, liquor is expressed from the fish and covers them. The salted fish were stored for about 9 months at 15–20°C in order to allow the product to ripen. Samples of ripened anchovies were collected from seventeen factories for analysis.

Sensory analysis

Anchovies for sensory analysis were washed in water to remove adhering salt, filleted and examined by four expert assessors. A total of twenty-four fish from each production batch sampled were presented to the assessors in four batches of six fish each. The five factors: odour, flavour, colour, consistency and adherence were rated separately, according to the scale shown in Table 1, and the sample mean was calculated from all factors over the four sets.

Table 1. Sensory scoring scheme for ripened anchovies

Factor	Sensory score				
	100	80	60	40	20
Flavour (disregarding salt)	Strong ham-like cured meat	Ham-like	Ham-like, slightly like mild cheese	Slightly ham-like. Very slightly rancid	Rancid, off-flavours
Flesh-colour	Uniformly pink	Pinkish, red or pink in the middle	Pinkish, deep red or pink in the middle	Uneven pink, deep red in the middle. Dark red blots	Dark red, black red blots and/or black dots
Odour	Pleasant volatile esters, strong characteristic anchovy odour	Pleasant volatile esters. Characteristic anchovy odour	Volatile esters	Volatile esters, slightly rancid	Rancid, acid, ammoniacal or sulphurous off-odours
Flesh consistency	No elasticity, firm and resistant to finger pressure in the whole fish	Firm and resistant	Slightly elastic, moist	Elastic, moist	Friable
Adherence of flesh to back-bone	It separates neatly. Fillets completely	Very little adherence, it separates neatly	Adherent, it separates (incomplete filleting)	Adherent, does not separate easily	Flesh gets torn in the filleting process

Chemical analysis

Fish for chemical analysis were filleted, minced and analysed in duplicate. Total Ester Index was determined by a modification of the AOAC (1960) procedure (Filsinger *et al.*, 1982), salt content by the AOAC (1960) procedure and water content calculated from the loss in weight after drying at $105 \pm 1^\circ\text{C}$ for 24 hr.

Results and discussion

The scoring system described by Filsinger *et al.* (1982) was designed for evaluating the progress of ripening of anchovies from the initial stage through to the fully ripened product. On the basis of experience gained with that scale and following discussions with anchovy processors, a scale for rating the quality of matured anchovies was constructed (Table 1). On this scale, running from 0 to 100, the best quality has a score of 86 or greater, very good quality from 66 to 85, good quality from 46 to 65,

regular quality from 26 to 45 and anchovies with a score of 25 or less correspond to spoiled or over-ripe product.

The ratings given to the samples of anchovies are shown in Table 2, along with salt and water contents as determined by chemical analysis. Most samples fell in the very good quality grade (scores between 66 and 85) with one graded as best quality and six graded as good quality.

Table 2. Values of salt and water contents, sensory scores and water activity for ripened anchovies

Sample	Water content g H ₂ O/100 g fish	Salt content g NaCl/100 g fish	Water activity (<i>a_w</i>)	Sensory scores
1	45.66	19.00	0.70	62.2
2	50.05	19.65	0.72	70
3	48.07	17.54	0.74	77.4
4	48.79	19.05	0.72	78
5	50.42	18.11	0.74	70
6	53.21	18.09	0.76	72.5
7	51.42	17.48	0.75	68
8	51.72	18.59	0.74	75
9	52.6	19.27	0.74	85
10	52.14	16.95	0.77	90
11	49.95	18.29	0.74	59.5
12	49.89	18.82	0.73	66.2
13	49.94	21.29	0.69	69.4
14	49.86	20.41	0.71	60.4
15	53.59	20.25	0.73	58.5
16	48.80	19.53	0.71	69.3
17	49.70	19.42	0.72	80.6

Salt content in the water phase of salted products is important in inhibiting microbial spoilage while allowing reactions that produce the desired properties to proceed (Mossell & Ingram, 1955). A better measure of the ability of salt to preserve foods is given by the water activity (*a_w*) of the food rather than by the salt content alone. The *a_w* values of the anchovy samples were calculated from the expression

$$a_w = 1.002 - 0.042 M,$$

where *M* is the molarity of salt calculated in the water phase (Lupín *et al.*, 1981). This relationship is limited to the range of salt contents up to the point where the water phase is saturated, approximately 6.0 *M*, which gives a minimum *a_w* of 0.75.

The water activities calculated from the equation are shown in Table 2 but values of *a_w* below 0.75 almost certainly mean that undissolved salt was present in the anchovies as sampled, and do not indicate the true value. Furthermore, Doe *et al.* (1982) have shown that the *a_w* of wet salted fish cannot fall below 0.75 unless the product is dried. There is no obvious association between *a_w* as calculated and sensory score and, bearing in mind the doubt already expressed that the calculated *a_w* measures true *a_w* at these salt contents, it must be concluded that *a_w* does not influence quality.

There is no association between TEI and sensory score (Fig. 1). Filsinger *et al.* (1982) showed that the index increases during ripening to an asymptote but as samples reported on here were fully matured it would be expected that the values would be at the asymptote. The mean value was 10.9 with a standard error of 0.3

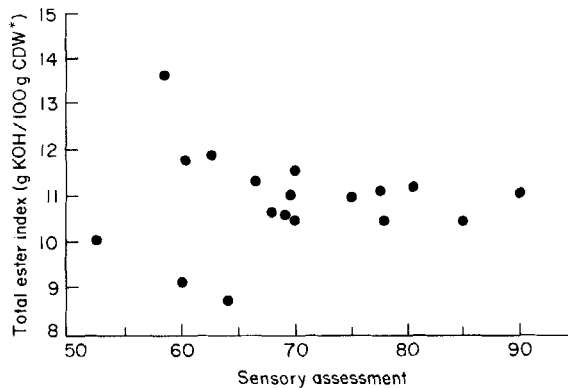


Figure 1. Total Ester Index versus sensory score.

*CDW = Corrected dry weight (Filsinger *et al.*, 1982).

The data presented here show that the quality of anchovies varies from batch to batch but this variation cannot be explained by variations in salt:water ratios at the completion of maturation. The Total Ester Index, although useful for indicating the progress of ripening, does not predict the quality of the ripened product.

Acknowledgments

Our grateful thanks are due to Mr Peter F. Howgate of the Torry Research Station, Aberdeen for assistance in revising the manuscript.

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(Received 15 February 1985, accepted 16 September 1986)