Nutritional, physical and microbiological properties of marinated Irish sprat (Sprattus sprattus)

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Introduction

Irish sprat is a largely under-utilised species for human consumption, while it is widely exploited for delicatessen production in Eastern European and Scandinavian countries. Sprat has a favourable nutritional profile, containing high amounts of long chain omega-3 fatty acids, high quality protein, vitamins and bioactive peptides.

Sprat landings in Ireland are advised at less than 3000 t/a (Marine Institute, 2017) and recent estimates indicate commercial values of around 150-200€/t (SFPA 2016). Therefore there is scope to add value to this nutritious resource by increasing the use of this species for direct human consumption, rather than fishmeal production or sale of frozen blocks for further processing abroad.

This study investigated the potential to develop and produce a high-quality food product from Irish sprat, using local ingredients and evaluated chemical, physical, and microbiological properties of sprats during the curing and marination process.

Materials

Irish sprat (*Sprattus sprattus*) was caught in Bantry Bay (Co. Cork, Ireland) in September 2019 and landed in Castletownbere. Fresh sprats were purchased from Mary's Fish Company (Galway, Ireland), blast frozen (-35ºC) for 12 h and kept at -18ºC prior to use.

Process

Thawed sprat
1ºC, 24 h
↓
Washing
↓
Heading, gutting and filleting
↓
Washing
↓
Brining
10% NaCl (w/v), 20ºC, 1 h.
↓
Marinating
10% NaCl(w/v), 15% sugar (w/v), 25% white vinegar (v/v), 35% cider vinegar (v/v), 20ºC , 168 h
↓
Storing
4ºC, 16 weeks

Methods

Proximate Analysis

Water content was measured by using the oven-drying procedure according to the 950.46, AOAC 2006. The percentage dry matter was calculated as a difference in a sample weight before and after drying

Protein content was determined using salt/alkaline protein extraction followed by bicinchoninic acid (BCA) colorimetric detection assay using a microplate reader. The microplate was incubated at 37°C for 30 min, cooled and the absorbance was determined at 562nm

Fat content was determined by a solvent extraction method in the Soxhlet apparatus according to AOAC 991.36 1997. The percentage of fat was calculated based on difference on sample weight before and after extraction

Total mineral content was determined by ashing at 500 °C for 5 h in a muffle furnace as described by the AOAC method 920.153, 1995. The ash content was calculated based on difference in sample weight before and after burning

Physical Analysis

The pH measured in triplicates using a pH meter on fish homogenate in a ratio of fish: distilled water 1:2 (v/v)

The sodium chloride content was determined by salt extraction and by spectrophotometric measurement of turbidity (Zhang and Xia, 2008). After incubation at 60ºC for 10 min, the absorbance was measured 45 min at 385 nm

The colorimetric values of the fish samples were measured using a Minolta chromameter CR-400 in the L, a, b colour space. The colour measurements were performed on the top, middle and a bottom of the flesh side of the fish

Textural properties were measured using a Texture Analyzer TA.XT2 equipped with a rectangular flat-ended 12 mm blade (Warner-Bratzler Shear Force). The cutting speed was 2 mm/s and the distance 20.0 mm. The hardness of samples was measured on three locations along the fillet (top, middle and bottom)

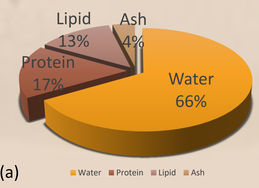
Micro-biological Analysis

Total Viable Bacterial Count (TVBC), Total Psychrophilic Bacterial Count (TPBC), Total yeast and mould (TYM), and Total Coliform Count (TCC) were determined on the sprat samples

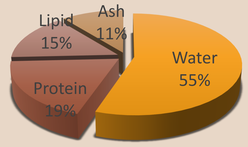
TVBC and TPBC were determined by using surface spreading method and Plate Count Agar. Plates were incubated at 37°C for 48 h (Kocatepe et al, 2019) and at 7°C for 10 d, respectively (Kilinc and Cakli, 2004). TYM were grown on Sabouraud Dextrose Agar at 30°C for 48 h (Ndaw et al, 2008) while TCC were incubated on Mc Conkey agar at 37°C for 48 h (Kilinc and Cakli, 2004)

Results

Proximate Analysis



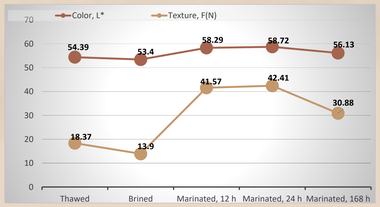
(a)



(b)

Fig 1. Proximate Analysis of (a) fresh and (b) marinated sprat

Physical Analysis



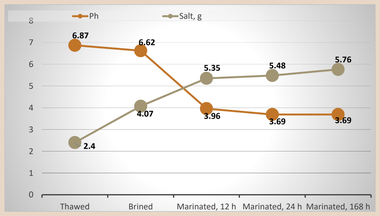


Fig2. Physical Analysis of sprat fillet in different stages of the production process

Microbiological Analysis

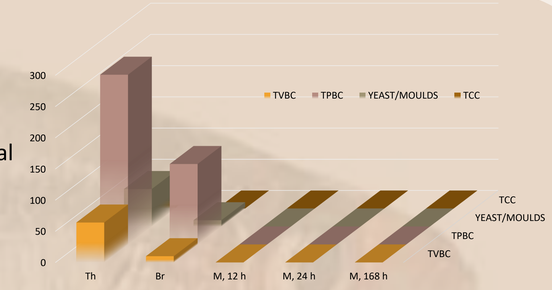


Fig 3. Microbiological Analysis of sprat fillet in different stages of the marinating process

Conclusions

- The present study indicated that marinated product made from Irish sprat maintained the highly nutritious characteristics of the fresh fish, as the cold marination process did not reduce significantly the proportion of protein, fat and minerals.
- Brining prior to marination had a whitening effect on colour and increased the firmness of the flesh, which is potentially beneficial from a consumer's point of view.
- During the curing process a gradual increase of NaCl was observed accompanied by a decreasing in water content, as a result of osmosis between fish tissue and brine.
- During the first 24 h-marination pH decreased significantly from 6.62 to 3.69. After this "variable grade period" of rapidly changing pH, the value was constant throughout the rest of the process.
- The influence of acid and salt showed a significant preservative effect, as microbial growth across all curing stages was inhibited.
- Marination showed a nutritional preservation function while also imparting desirable sensory characteristics and adding value to underutilized species.
- The next step of the project will involve formal sensory evaluation of the developed sprat product and comparison with similar commercially available products.

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