Utilization of Fishery By Products: Designing a Standardized Process to Produce Fish Broth

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Introduction

Globally, 50–60% of seafood biomass is discarded post-filleting, representing lost protein, collagen, and economic value. In Cuba, ~936 metric tons of snapper (Lutjanus spp.) by-products are generated annually, yet organizational and technological constraints limit its systematic valorization.

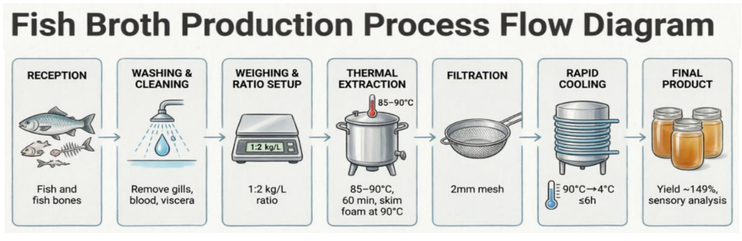
Problem statement

Can a reproducible, safe, and neutral broth be produced from white-fish heads/bones using feasible thermal operations aligned with Cuban industrial conditions?

Objectives

- Optimize extraction parameters (temperature/time), validate active cooling trajectories, quantify product yield, and construct a mass balance.
- Benchmark sensory attributes against commercial references.
- Develop an evidence-based HACCP plan aligned with FDA guidance and Cuban operational realities.

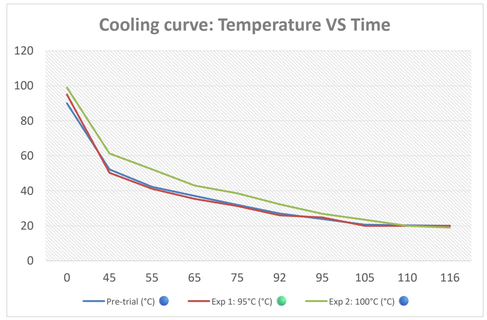
Methodology

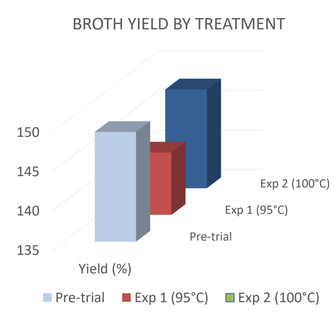


Pre-trial validation conducted with saithe (*Pollachius virens*) to refine filtration sequencing and monitoring accuracy.

Results

Broth yield (% w/w relative to cleaned raw material) for three extraction treatments. Average yield of 146.4% was used for mass balance scaling.





Sensory Evaluation Summary

The sensory evaluation results showed skin and viscera taste were noticeable to the panelists. Temperature modulation alone cannot achieve complete sensory neutrality. A sensory score sheet was developed for specific product characteristics.

A HACCP plan was constructed for the designed process flow.
All critical limits grounded in empirical pilot data, not theoretical assumptions. Plan aligns with FDA guidance.

Critical Control Points Established

CCP	Process Step	Critical Limit	Monitoring
CCP 1	Raw material reception	Temperature ≤ 4 °C	Thermometer log per batch
CCP 2	Thermal extraction	85–90 °C for ≥ 60 min	Continuous probe + timer
CCP 3	Filtration (2 mm)	Mesh integrity; no visible particles	Visual pre/post inspection
CCP 4	Rapid cooling	90→20 °C ≤ 2 h; → 4 °C ≤ 6 h total	Temp log every 30 min

Conclusions

- Sub-boiling extraction (85–90 °C, 60 min) optimized collagen yield while preserving broth clarity for warm-water snapper. Active chilling achieved across all thermal loads.
- **146% broth yield** (w/w) from cleaned frames confirms efficient conversion of waste into marketable ingredient.
- 95 °C batch offered best clarity/neutrality balance; 100 °C increased richness but compromised visual appeal.
- Evidence-based HACCP plan established 4 CCPs grounded in pilot data, not theory.

Overall Impact

A low-capital, thermally driven process can safely transform fish waste by-products into a standardized culinary ingredient—supporting Cuba's circular bioeconomy with minimal infrastructure investment.

Recommendations

- Standardize gill/viscera removal and bleeding at filleting more than downstream correction.
- Embed HACCP monitoring into daily operator tasks—safety.
- Plan secondary valorization of solid residue (animal feed, mineral supplements) to close the material loop.

Acknowledgments

GRO·FTP Fisheries Training Programme
unesco United Nations Educational, Scientific and Cultural Organization
matís
EPICOL Empresa Pesquera Industrial de La Coloma