Utilization of submicro fish bone in Alask pollock fillets for improved quality

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Special thanks to the PCCRC for funding this project

Introduction

Annual Alaska pollock harvests have consistently averaged 1.5 million metric ton for the last four years and is designated a sustainable fishery. Current utilization levels for human consumption are nearly 50%. Fish bone represents 10-15% of total fish weight and is primarily utilized as bone meal or discarded as waste. Developing higher value uses for fish bone could significantly increase utilization and value of the Alaska pollock fishery. Recovery of Alaska pollock fish bone for use as a natural, nutritional source of highly bioavailable calcium is a new approach to reduce fish processing solid waste.

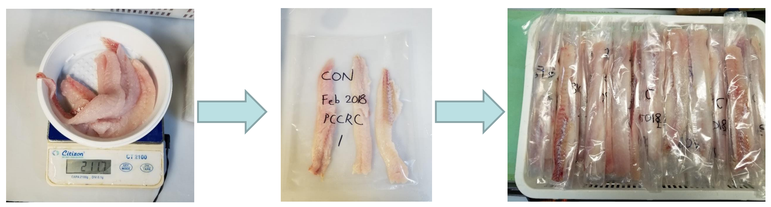
Objective

The objective of this research was to incorporate submicro fish bone as a marinade with pollock surimi proteins for injection into Alaska pollock fillets for improved quality and nutritional calcium content.

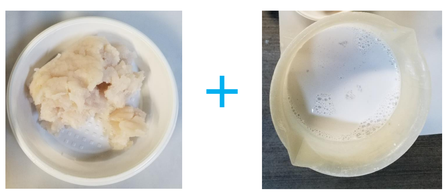
Materials & Methods

Frozen Alaska pollock fish frames were obtained from UniSea (Dutch Harbor, AK). Frozen blocks of fish frames were thawed overnight in a 4-5°C cold room. In order to remove muscle and/or skin, scales, floating fat, and collagen, thawed fish frames were placed in a pan and filled partway with water. The frames were then heated at 125°C for 1 hour under pressure (0.2 MPa). After heating, the liquid faction was decanted and remaining fish bone and materials were repeatedly rinsed with water until all visible debris was removed. Recovered bone was then dried in a 105°C oven for 16 hr. Then the dried bone was finely ground using a Stephan UM 5 Universal chopper to obtain <150 µm bone powder. The fish bone was then mixed with distilled water to mill a 10% solution of submicro fish bone (SMFB) using a MinZeta wet mill. The final particle size of the SMFB after 4 hours of milling was ≤150 nm.

Treatment of fresh Alaska pollock fillets was conducted at Trident Seafoods (Kodiak, AK). Control fillets were weighed in groups of 3 fillets each. Packed into plastic bags and sealed without vacuum. Bags were then rolled and placed into a tote.



Surimi proteins and SMFB were combined using a homogenizer to prepare CalPro marinade.



AP surimi + 10% slurry AP-SMFB = **CalPro Marinade (CPM)**

Treatments were defined as follows:

- **CON**-no marinade treatment
- **CPM1**-(CalPro marinade: 95.0% SMFB; 5.0% SMFB)
- **CPM2**-(CalPro marinade: 92.5% SMFB; 7.5% SMFB)
- **CPM3**-(CalPro marinade: 90.0% SMFB; 10.0% SMFB)

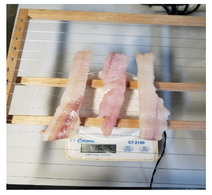
Materials & Methods (continued)

CalPro marinade was then incorporated into fresh AP fillets as follows:

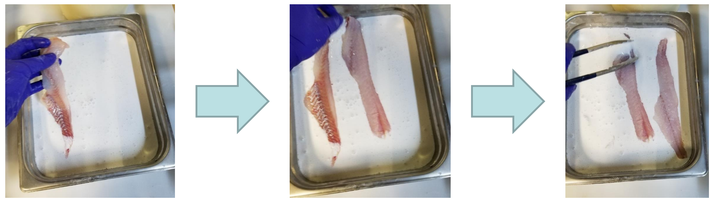
Step 1: Poke fillets on both sides

Step 2: Tare scale with rack

Step 3: Weigh fillets



Step 4: Submerge each of three fillets into CalPro marinade and soak for 2 min



Step 5: Drain fillets 2 min

Step 6: Weigh fillets

Step 7: Package and freeze

All treatments were then frozen in a -20°C freezer and then transported under cold storage to the OSU Seafood Lab for evaluation of physical (drip loss, cook loss, Warner-Bratzer compression force) and chemical properties (salt soluble protein content, surface reactive sulfhydryl groups, surface hydrophobicity, TBARS) after 0 (within one week of preparation), 10, 20, 30 and 40 weeks of frozen storage.

Results

Uptake of CalPro marinade averaged 13.1-14.8% and calcium content increased by 37.1-41.7% (**Figure 1**).

Nutrition Claims:

RDA Calcium =1000 mg

- **≥10% (100 mg+) =** "fortified" or "enriched"
- **10-19% (100-190 mg) =** "good source", or "contains" or "provides"
- **20%+ (200 mg+) =** "excellent source"

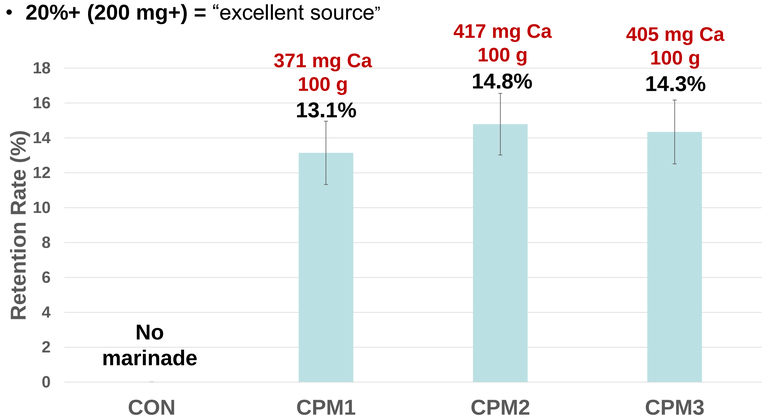
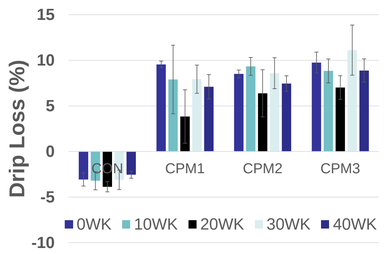
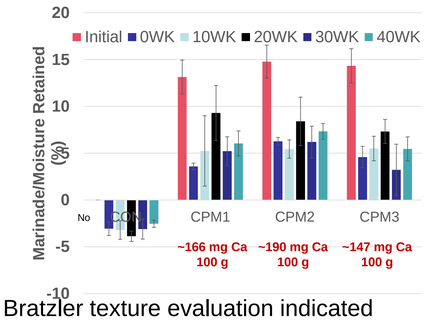


Figure 1. Uptake (%) of CalPro marinade and calculated calcium content increase (mg Ca/100 g)

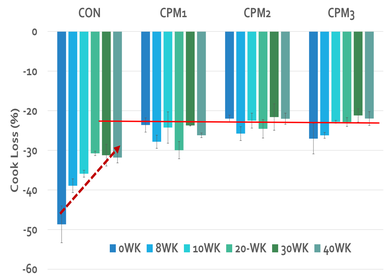
Results (continued)

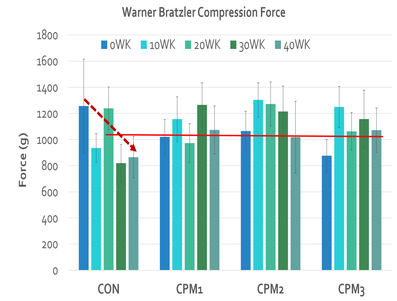
There was a significant difference in drip loss between control and CPM treatments. Consequently, approximately 5% of the CPM marinade remained in the fillets from 0-40 weeks of frozen storage.
A minimum content of calcium remaining in the CPM fillets averaged 0.166% (166 mg/100g); .190% (190 mg/100g); .147% 147 mg/100g, which allows for a minimum labeling claim for calcium content as "good source, contains, or provides".



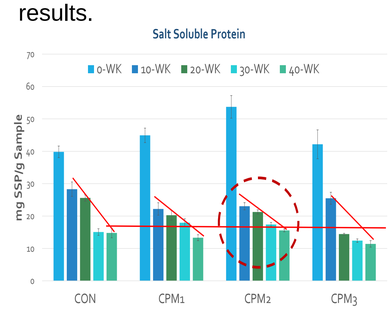


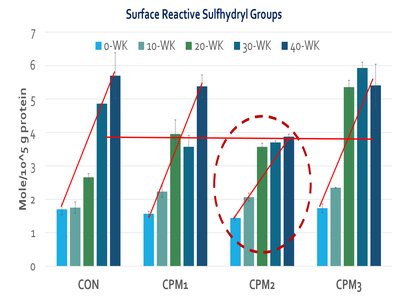
Compression force (g) from Warner Bratzler texture evaluation indicated that in addition to maintaining more consistent drip loss, CPM treatment resulted in consistent texture that was better than CON.





CPM treatment, particularly CPM2, protected fish protein from denaturation during 40 weeks of frozen storage compared to CON. This is shown by less sever decrease in salt soluble protein content and reduced exposure of surface reactive sulfhydryl groups. The results from these chemical tests also correspond to results from texture and cook loss results.





Other chemical tests (surface hydrophobicity and TBARS- data not shown) did not demonstrate significant difference between treatments.

Conclusions

- Compared to CON, addition of submicro fish bone and surimi protein slurry (CalPro) improved fillet quality during 40 weeks of frozen storage.
- CPM2 reduced protein denaturation/improved protein stability and better maintained textural properties as supported by improved marinade retention, and lower cook loss/drip loss.
- **Alaska pollock fish bone could be effectively utilized as a marinade with surimi fish proteins to improve texture and calcium content of frozen Alaska pollock fillets.**