



Seafood Pilot Plant



Aquaculture Facility



Bioprocessing Pilot Plant



Bioprocessing Laboratory

# Development of canned pet food from cod (*Gadus morhua*) by-products

Submitted to: Land and Sea Pets Inc.

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## **Development of canned pet food from cod (*Gadus morhua*) by-products**

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## ACKNOWLEDGEMENT

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## EXECUTIVE SUMMARY

Land and Sea Pets Inc. (the client) was conceived by Chadwick Wiseman and is run by Chad with his father, Clayton Wiseman. Chad's experience running a creative marketing agency along with Clayton's long career in manufacturing are the driving forces behind Land & Sea Pets. The focus of the Land & Sea Pets brand development is to offer a line of high-quality, consistent pet food products.

The client's mission is to use cod by-products exclusively from Newfoundland & Labrador to create premium pet consumables. To help achieve this, the client requested assistance from the Center for Aquaculture and Seafood Development (CASD) and the Canadian Centre for Fisheries Innovation (CCFI) to assist with the development of a shelf stable, single ingredient, clean label pet food containing only cod and water. The client envisions that this product will contribute to resource conservation by enhancing the utilization of Newfoundland and Labrador cod by-products.

The objectives of this project were as follows:

1. Develop the recipe for a thermally processed pet food using locally sourced cod by-products.
2. Develop, at pilot scale, a production schedule that ensures the product is commercially sterile.
3. Provide the client with product samples that can be used to assist the client with expanding their product line.

In addition to these client-focused objectives, this project strives to meet the following objectives:

1. Improve resource conservation, sustainability, and value by utilizing cod by-products.
2. Prepare the product in cans to help ensure that the packaging is recyclable.

Four initial products were developed and reviewed with the client. CASD technologists were to proceed with two cod in water products. However, the aluminum cans that CASD's can seamer is set up to process are no longer readily available and CASD technologists were unable to properly seam steel cans which are the current standard with CASD's existing can seamer. Alternative container options were proposed but did not meet the client's expectations and a new can seamer could not be procured within the project's timeline. As a result, test market samples could not be produced. This was both unexpected and unfortunate.

The following conclusions drawn from this project are:

1. High-end, clean label pet foods can be manufactured from cod by-products.
2. A 90 s steam precook (min) is recommended to maximize the drained weight.
3. Adding fresh water to the can to cover the product was recommended to minimize scorching.
4. Product can be ground for smaller pets and chunked for larger pets.

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5. Smaller rib bones and pin bones can be safely added to the product to improve calcium content without creating a choking hazard. Heavier bones should be removed.

The CASD technologists make the following recommendations based on this analysis.

1. Initial production volumes will be small (5000 lbs/year). Therefore, the client should work with a co-packer to minimize their up-front investment while volumes increase, and additional product lines are brought on stream.
2. As discussed with the client during the first production run, cans with an easy-off lid that do not require a can opener would likely be preferable for consumers.

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## 1 BACKGROUND AND INTRODUCTION

Land and Sea Pets Inc. (the client) was created by Chadwick Wiseman in 2021 with the help of his father, Clayton Wiseman. The company, headquartered in Trinity, Newfoundland, up-cycles cod by products into premium pet treats. While Clayton draws on his vast experience in production and manufacturing to create effective processes to develop a high-quality, consistent product, Chad has focused on Land & Sea Pets product and brand development.

The client produces pet treats (Figure 1) using cod (*Gadus morhua*) by-products from licensed fish processors in Newfoundland & Labrador. Traditionally discarded in the filleting process, upcycled cod skins provide pets with protein, Omega 3 fatty acids, and collagen to promote healthy skin, coat, and joints. These products and their associated Canada-wide distribution channels were developed, from the ground up, by the client.



(a) Whole, dried skins

(b) Cod skin bites, food topper and catnip

*Figure 1 - Land and Sea Pet Treats come in several formats including (a) whole, dried skins and (b) cod skin bites, food topper and catnip.*

## 2 SCOPE AND PURPOSE

### 2.1 Scope of Project

The client's mission is to use cod by-products exclusively from Newfoundland & Labrador to create premium pet consumables. To expand their product line, the client would like their product line to include a shelf stable pet food product.

### 2.2 Purpose of Project

The client requested assistance from the Center for Aquaculture and Seafood Development (C ASD) and the Canadian Centre for Fisheries Innovation (CCFI) to assist with the development of a shelf stable pet food. Upon initial discussions with the client, the product is to be a single ingredient, clean label product, containing only cod and water.

This project will contribute to resource conservation by enhancing the utilization of Newfoundland and Labrador cod by-products.

## 3 OBJECTIVES

The objectives of this project are as follows:

1. Develop the recipe for a thermally processed pet food using locally sourced cod by-products.
2. Develop, at pilot scale, a production schedule that ensures the product is commercially sterile.
3. Provide the client with product samples that can be used to assist the client with expanding their product line.

In addition to these client-focused objectives, this project strives to meet the following objectives:

1. Improve resource conservation, sustainability, and value by utilizing cod by-products.
2. Prepare the product in cans to help ensure that the packaging is recyclable.

## 4 METHODS

### 4.1 Raw material

The client shipped 30 kg of Atlantic cod napes to C ASD as raw material (Figure 2) for the canned food product development work. This raw material was frozen and in good condition upon receipt. Cans and lids (Figure 3) were obtained from C ASD inventory to be sealed in the C ASD vacuum can seamer. Vegetable

oil was purchased from a local grocery store (The addition of vegetable oil was investigated to prevent surface scorching inside the can)



*Figure 2 - Raw material supplied by client.*



*Figure 3 - Steel cans and lids (307 x 111).*

## 4.2 Development of pre-cook

Food that is prepared for canning undergoes a specific preparation process, which ensures the final product in the can has the desired texture and drained weight.

A pre-cook is commonly used in the preparation process. In a pre-cook, the normal water loss that occurs when meat or fish is cooked occurs before the product is placed inside the cans, thereby allowing for better control and consistency of the final drained weight of the canned product.

In the pre-cook, it is desired to induce some shrinkage and water loss but not too much, so that the canned product contains mainly meat with some liquid covering it fully, which is important for efficient heat transfer. The type and cut of a fish/meat affects its water loss during cooking. Therefore, an evaluation of the water loss during pre-cook is an important product development step.

To get an initial assessment of water loss behaviour during the pre-cook, 10 kg of cod napes was subdivided into six lots; each lot was weighed; cooked in the steam oven at 121°C for 1, 1.5, 2, 4, 10 and 15 minutes; allowed to drain for 5 minutes; and reweighed. Percent water loss was calculated using Eq 1 for each cook time.

$$L = \frac{W_i - W_f}{W_i} * 100 \quad (1)$$

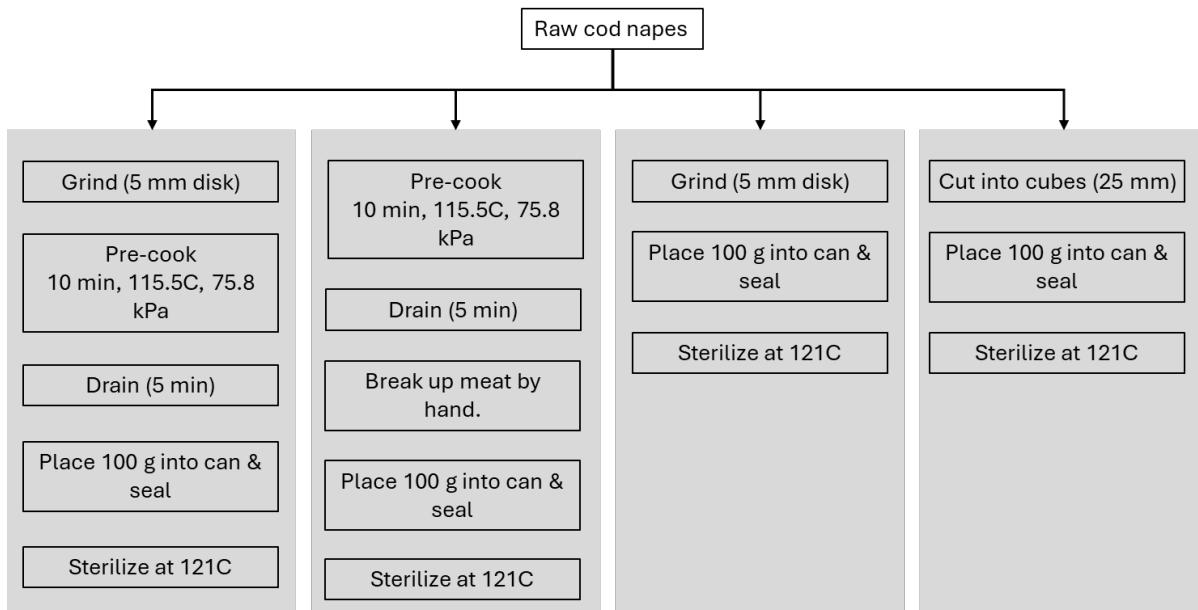
Where  $L$  = water loss (%),  $W_i$  = initial sample weight (g), and  $W_f$  = final sample weight (g).

### 4.3 Evaluation of the thermal sterilization process

Following the water loss assessment, CASD technologists evaluated the effects of the pre-cook and the sterilization process on product texture and drain weight. Four subsets of samples were prepared as outlined in Figure 4.

CASD technologists placed ~100 g of product in each of 16 aluminum cans and sealed them. These cans were subdivided into four subsets: the product could be chunked (25mm cubes) or ground (5mm disk), and the product could be placed in the cans raw or precooked (100°C for 10 minutes). Four cans, one for each subset, were selected to have thermocouples installed and placed randomly in the retort. The retort was closed, and the product was cooked at 121°C until commercial sterility was reached in all four monitored cans.

After retorting and cooling of the cans, the cans were opened. The appearance was evaluated visually, and a picture was taken. Following that, one can from each product/process group was opened and the product was placed on a screen and allowed to drain for 5 minutes before being reweighed. The additional water weight loss observed during retorting was calculated.



*Figure 4: Sample preparation for initial thermal processing test*

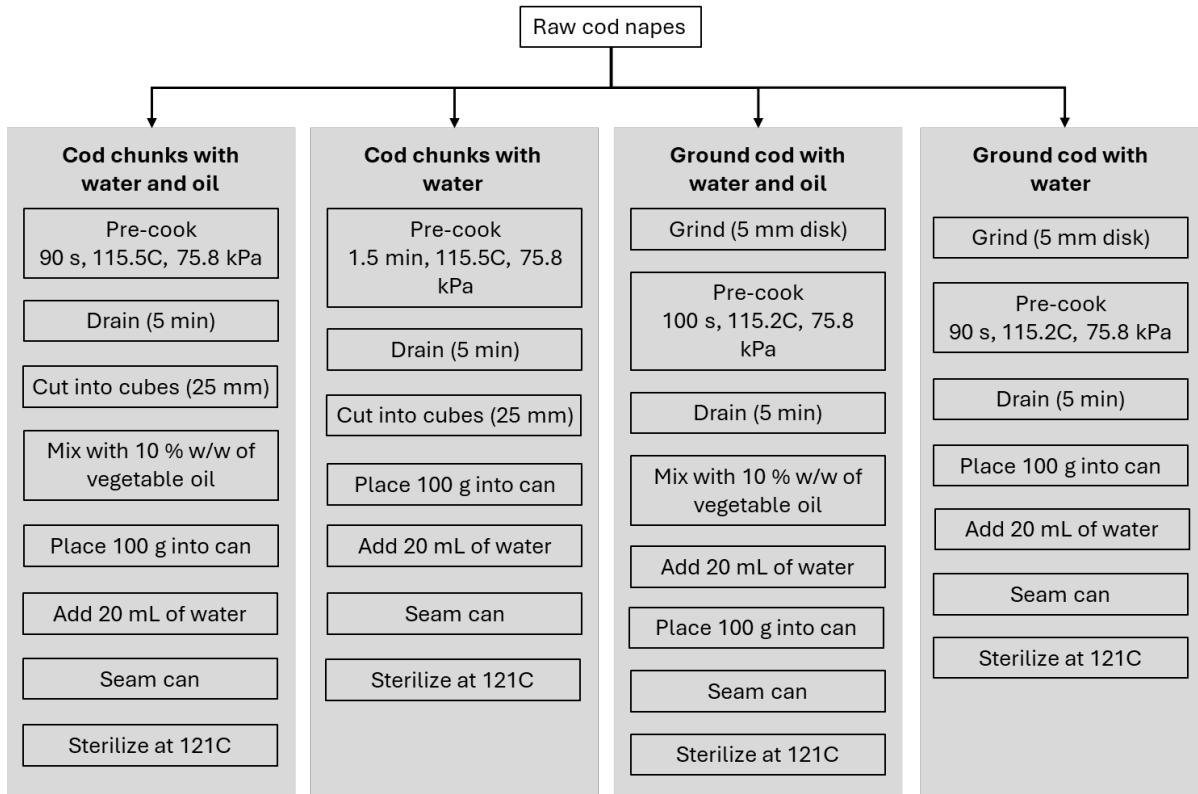
#### 4.4 Preparation of samples for sensory assessment

Incorporating the lessons learned from section 4.3, CASD technologists proceeded with four new recipes to prepare samples for sensory assessment with the client. Figure 5 outlines the production process for each sample.

The first recipe prepared cod chunks with water and oil. CASD technologists steamed 1800 g of cod napes at 75.8 kPa steam (115.5°C) for 90 s. The product was then drained and cut into 25 mm chunks. CASD technologists then blended 1000 g of the cod chunks with 100 g of oil. Last, CASD technologists filled each can with 100 g of the cod product and topped each can up with 20 g of fresh water to ensure the product was covered before the cans were seamed.

To produce cod chunks with water, CASD technologists steamed 1782.8 g of cod napes at 75.8 kPa steam (115.5°C) for 90 s. The product was then drained and cut into 25 mm chunks. Last, CASD technologists filled each can with 100 g of cod and topped each can up with 20 g of fresh water to ensure the product was covered before the cans were seamed.

To produce ground cod with water and oil. CASD technologists ground 1315.7 g of cod napes using a meat grinder with a 5 mm disk. The product was steamed at 75.8 kPa steam (115.5°C) for 1 min 40 sec and drained. CASD technologists then blended 1000 g of cod with 100 g of oil. Last, CASD technologists filled each can with 100 g of cod and topped each can up with 20 g of fresh water to ensure the product was covered before the cans were seamed.



*Figure 5: Sample preparation process for sensory evaluation*

Lastly, to produce ground cod with water, CASD technologists ground 1362.8 g of cod napes using a 5 mm disk. The product was steamed at 75.8 kPa steam (115.5°C) for 1.5 min and drained. Last, CASD technologists filled each can with 100 g of cod and topped each can up with 20 g of fresh water to ensure the product was covered before the cans were seamed.

After retorting and cooling of the cans, the cans were opened. The appearance was evaluated visually, and a picture was taken. Following that, one can from each product/process group was opened and the product was placed on a screen and allowed to drain for 5 minutes before being reweighed. The additional water weight loss observed during retorting was calculated.

Together with the client, CASD technologists performed a sensory evaluation of the products by assessing the visual appeal, smell, colour, taste and texture.

#### 4.5 Test market samples

Food-grade cans and lids have very specific measurements for their double seam and a seamer capable of meeting these seam specifications must be available to produce canned foods to commercial specifications.

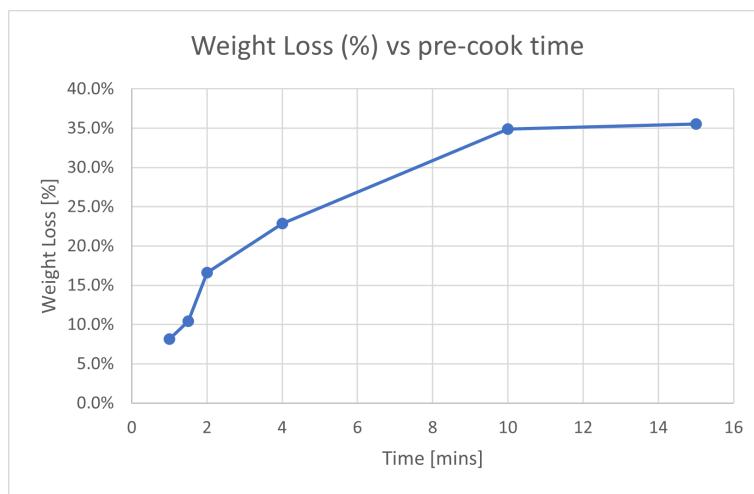
To produce test market samples for the client, the CASD had to purchase new cans and adjust the seamer to produce an acceptable double seam.

The plan was to repeat the production of chunked and ground cod without the addition of oil (Figure 5) and provide samples to the client for hand-out to prospective clients.

## 5 RESULTS

### 5.1 Development of the pre-cook

Data from pre-cook experiments showed that the cod napes lost the maximum amount of water within 10 min of steaming (Figure 6).



*Figure 6- Percent weight loss in cod napes as a function of cook time (100°C) in minutes.*

### 5.2 Evaluation of the thermal sterilization process

A 10 min pre-cook resulted in a weight loss of 35% (1706.3 g of raw cod napes was reduced to 111.3 g after the pre-cook). The pre-cooked product was split into two lots: half was cut into chunks and half was ground.

Can contents and water weight loss from retorting are summarized in Table 1. Results showed that the pre-cooked samples did not lose much water during the retorting process (< 5%). The average water loss for the eight cans with precooked product was 3.1%. In contrast, the average water loss for the eight cans containing raw product was 31.9%.

**Table 1 - The effect of pre-cook and pre-processing on cooking loss for the initial samples.**

Tin	Product	Process	Avg. Raw Wt. [g]	Avg. Cooked Wt. [g]	Avg. Wt. Loss [%]
1	Chunk	Raw	100.8	64.7	35.6
2	Chunk	Cooked	101.0	96.4	4.6
3	Ground	Raw	101.0	73.3	28.1
4	Ground	Cooked	100.7	98.8	1.5

Figure 7 shows the can contents before and after retorting. Samples that were pre-cooked were very dry as almost no additional water loss was observed during retorting. Some scorching was observed on the surface.

Samples that were placed into the can raw had coagulated cooked protein on top of the product. (Figure 7 a & c). While this is protein and nutritious for pets, many pet owners might find it unappealing. For the precooked samples (Figure 7 b & d), CASD technologists mixed this coagulated protein back in with the solids before filling the cans and this protein was not observed in the final product.

A chunky appearance could only be achieved if raw cod was placed into the cans because the pre-cook softens the cod so that cutting it into chunks is no longer possible.

On all samples, some mild scorching of some of the product on top was noticeable.

Based on the results, it was recommended that:

1. The pre-cook is shortened to 90 s to achieve a water loss that is typical for canned fish products
2. The client requested a product only containing fish and water. However, to prevent surface scorching, it was recommended to investigate if a small amount of oil added to the product before retorting can prevent surface scorching.

After discussions with the client, it was decided that CASD technologists should continue with both product forms (i.e., chunks and ground). The larger chunks might be best for medium-large dogs while the ground product might be better suited for cats and small dogs.

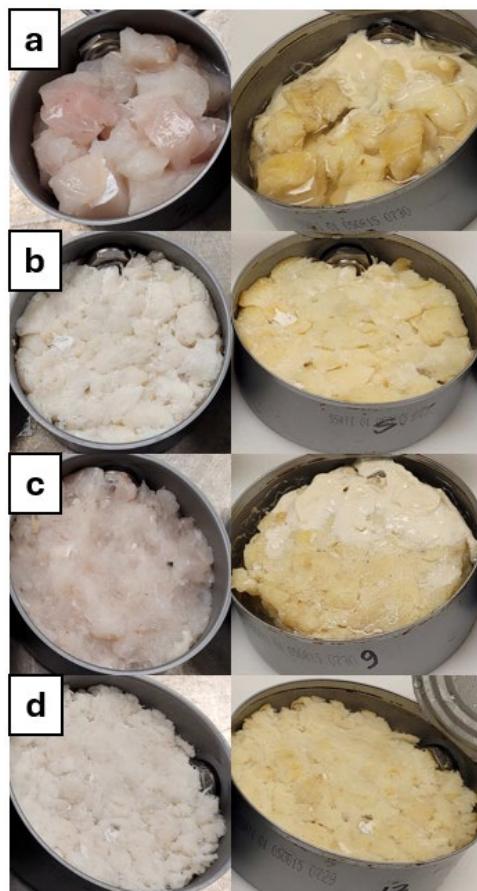
Lastly, CASD technologists did not remove the small pin bones from the product. After retorting, the pin bones were soft, pliable and should be easily digested to provide some dietary calcium. CASD technologists recommended assessing how the larger rib bones soften during future runs.

### 5.3 Preparation of samples for sensory assessment

Based on the initial evaluation of the pre-cook process and thermal process, four samples were produced according to the process described in Figure 5 for sensory evaluation at the CASD Seafood Pilot Plant together with the client.

Initial water loss from the steaming process occurred as follows:

- The final weight of the chunked cod in oil product was 1617.3 g for a 10.2% water loss.
- The final weight of the chunked cod in water product was 1564.5 g for a 12.2% water loss.
- The final weight of the ground cod in oil product was 1121.0 g for a 14.8% water loss.
- The final weight of the ground cod in water product was 1200.2 g for a 11.9% water loss.



*Figure 7 - Initial products before and after thermal processing: a) chunked, raw initial product; b) chunked, precooked initial product; c) ground, raw initial product; and d) ground, precooked initial product.*

Figure 8 and Figure 9 show whole and ground cod napes after the shortened pre-cook. While some product shrinkage was observed, the product is still juicy and not fully cooked.

Can contents and weights are summarized in Table 2. Results showed that the average water loss from retorting for the chunked product was 18.0% while the average water loss from retorting for the ground product was 16.3%. Pictures of each product after retorting (Figure 10) and draining (Figure 11) are shown below.

Overall, the visual appearance was good for all samples. The shorter pre-cook resulted in an acceptable solid/liquid ratio inside the cans. Scorching was not observed, even in samples without the addition of oil. Due to the removal of some protein-rich water from the pre-cook (see process description in Figure 5), no congealed protein was accumulated on top of the product.

The client was pleased with the results of the initial production run. To keep with the initial plan to make a white-label product with only cod and water as ingredients, the product without oil was preferred.



*Figure 8 - Cod napes after a 90-second precook. Meat shrinkage is achieved but it is not fully cooked and still juicy.*



**Figure 9 – Ground cod napes after a 90-second precook. Some shrinkage is observed but the cod napes are still juicy.**

**Table 2 - The effect of precook and pre-processing on cooking loss for the initial client samples.**

Tin	Product	Process	Avg. Raw Wt. [g]	Avg. Cooked Wt. [g]	Avg. Wt. Loss [%]
1	Chunk	Oil	100.4	82.1	18.2
2	Chunk	Water	101.1	83.1	17.8
3	Ground	Oil	101.9	84.6	17.0
4	Ground	Water	100.3	84.7	15.6



Figure 10 - Cooked product (not drained). L-R: chunked cod with oil, chunked cod without oil, ground cod with oil, and ground cod without oil.



Figure 11 - Cooked product (drained). L-R: chunked cod with oil, chunked cod without oil, ground cod with oil, and ground cod without oil.

#### 5.4 Test market samples

Unfortunately, test market samples could not be produced due to unforeseen technical challenges with the can seamer and the availability of suitable cans.

In short:

- The type of can that the CASD's seamer can seam have been discontinued.
- The CASD's seamer cannot seam the type of can that is now available for purchase.

To solve the issue, the following solutions were investigated:

- A senior thermal processing authority was consulted to help adjust seamer setting to the new can.
- The seamer manufacturer was also consulted. It was suggested that the seamer needs refurbishment or replacement.

- The CASD looked for availability of a local can seamer that could be purchased or rented.
- Alternative container options such as glass jars, laminated foil pouches, or composite cans were discussed with the client. The client did not want to move ahead with any of these options.
- Funding was secured in December 2024 to purchase a new can seamer, however, the vendor was unable to meet our timeline.

## 6 DISCUSSION

In this study, a canned pet food made from cod by-product and water was developed on a small-scale. By precooking for 90 s prior to filling the cans, CASD technologists were able to produce a product that lost between 15.6 to 18.2% water weight. Based on Canadian labelling requirements, gross weight and drained weight must be listed on the package. Based on CASD's test, for the worst-case ground cod scenario, the label would list: weight = 120 g, drained weight = 84.6 g (representing a water loss of 29.5%). For comparison, a typical canned tuna package available in Canada lists: weight = 184 g, drained weight = 133 g (representing a water loss of 27.7% loss).

Overall, the client was satisfied with the product and ready to demonstrate samples to prospective buyers. Once a matching can & seamer are in place at the CASD or elsewhere, the client can utilize the developed knowledge to advance his production plans.

## 7 CONCLUSIONS

The following conclusions are drawn from this project:

1. High-end, clean label pet foods can be manufactured from cod by-products.
2. The process identified to produce the preferred product was as follows:
  - a. Grinding through 5 mm meat grinder for small pets
  - b. No cutting of raw material for larger pets
  - c. 90 s steam pre-cook (108.4°C, 7 psi), followed by 5 min draining
  - d. Fill each can with 100 g of cod + 20 mL of water
  - e. Retort at 121°C to commercial sterility
3. Pin bones are brittle and significantly softened by the retort process and do not appear to be a safety hazard. Heavier bones (such as the collarbone or rib bones) should be removed.

## 8 RECOMMENDATIONS

Based on this assessment, the CASD recommends:

1. Since initial production volumes will be small (5000 lbs/year), the client should work with a co-packer to minimize their up-front investment while volumes increase, and additional product lines are brought on stream.

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2. As discussed with the client during the first production run, cans with an easy-off lid that do not require a can opener would likely be preferable for consumers.
3. The hardness of fishbones in the product and the potential associated hazards should be assessed by a veterinarian.