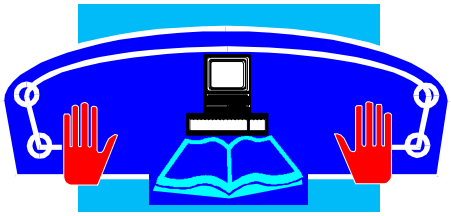

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Utilization of Seal Meat and Seal Offal

by

Bjarne Stormo

Tromso, October 1983

Utilization of Seal Meat and Seal Offal

(Utnyttelse av selkjott/selavfall)

by

Bjarne Stormo

Report No. 663.2-4-4, 30/10-1983

Norwegian Institute for Fisheries Technological Research, Tromso.

Abstract

A ban against dumping of seal carcasses on the sealing grounds in the "East Ice" (north-east of Finnmark) has made it necessary to take care of the carcasses if the hunt is to continue.

Experiments carried out over two seasons on the sealing grounds have shown that it is possible to do this with reasonable economic return. The meat that can be used for human food (backs (loin meat) and flippers) can be frozen in plate freezers and stored in cold storages on board. The rest of the carcass with guts, etc., can be ground up, preserved with acid and stored in tanks.

Seal meat and flippers can be used as raw material in certain types of salami-type sausages and ground-up products. Acid preserved seal offal (silage) is a valuable protein feed that can be used in the fur animal industry.

Marketing opportunities for silage are good, while the meat for human consumption will probably require considerable marketing effort.

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Summary

A ban against the dumping of seal carcasses on the sealing grounds in the East Ice has recently introduced the problem of how to take care of the total catch. p. I

In addition, frequent reductions of catch quotas in all areas make it necessary to better utilize the existing resources.

The total quota on the East Ice Sealing grounds was 18,000 animals this year. Estimating an average carcass weight (after skin and blubber are removed) of ca. 40 kg per animal, this represents a total raw material quantity Of 720,000 kg. Due to the special situation in the sealing industry at the present time, with uncertainty as to hunt on the other grounds (West Ice and Newfoundland) where the hunt to a large extent has been based on young animals, it would be difficult to estimate the potential raw material quantities from those areas. This report will therefore be based on the raw material from the quota in the East Ice.

Some meat from a seal carcass can be used for human consumption, estimated to be ca. 20%. The rest must be considered to be suitable for animal feed only. This year's quota in the East Ice could therefore mean ca. 144,000 kg for human consumption and ca. 576,000 kg for animal feed.

Of the meat for human consumption, ca. 50% is Pure meat cut from the back of the seal while the rest will consist of flippers with bone.

The meat tried in this experiment was preserved by freezing in vertical plate freezers and kept in frozen storage onboard. The animal feed was preserved with acid (silage) in fully automatic equipment and stored intanksonboard.

The silage becomes a pumpable mass that can be loaded and unloaded by pumping and the keeping quality can be characterized as being very good with a keeping time of at least one year.

With respect to the utilization of these two types of raw material, a number of experiments have been carried out at several meat processing plants in order to utilize seal meat as an ingredient in different products.

The products showing most promise after these trials are cured salami-type sausages and canned meat and meat cakes -(hamburgers) in special (gamey) gravy.

The silage has been tested at the Norwegian Agricultural College on fur animals (mink) with very good results, and possibilities for marketing this product to the fur industry are considered to be good. Efforts should also be made to market the product to the fish farming industry. Both offal from the meat packing industry and acid-preserved offal from the fishing industry ha been used in farms with good results. It is therefore assumed that acid-preserved seal offal should be a useful resource.

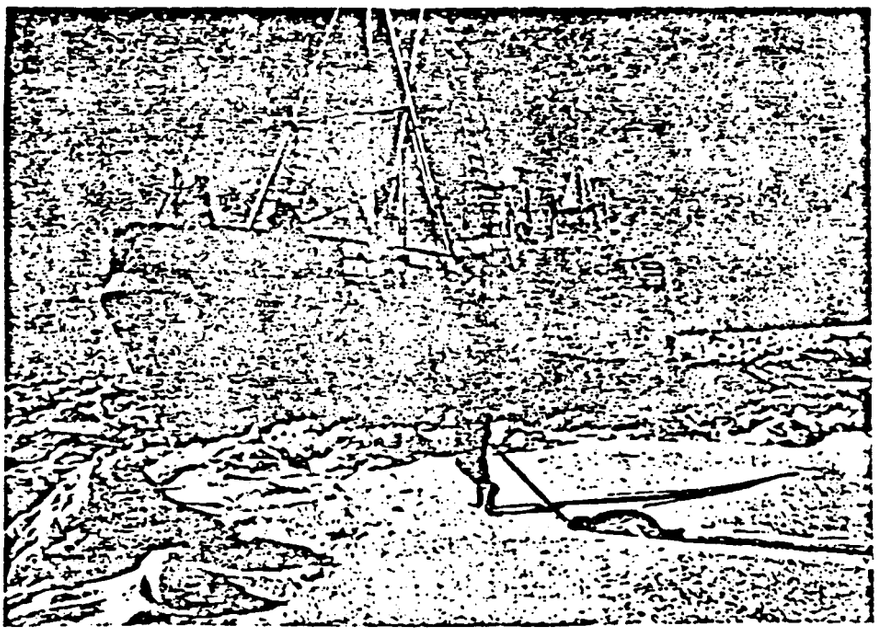
Economic calculations for the project gave the following results:

72,000 kg meat	kr 14.-/kg	= kr.	1,008,000 .-
72,000 kg flippers	kr 8.-/kg	= kr.	576,000.-
576,000 kg silage	kr 1.48/kg	= kr.	852,0000 -

Total first-hand value = 2,436,000.- kr

The economic calculations based on the number of seals killed in the East Ice in 1983 therefore show a total first-hand value of the seal carcasses of ca. 2.4 million kroner. This would have addedup to a total of kr. 500,000 per vessel (4 vessels participated in 1983). Total investments per vessel would be quite variable. However, in order to be able to both freeze and prepare silage onboard, estimated investments per vessel would be a minimum of 1 million kroner. p. III

Trials to utilize seal carcasses by these methods were carried out on board three sealing vessels in the 1982 and 1983 seasons. One of the vessels, M/V "Kvitbjorn" used the acid preservation method, while the other two, M/V "Nordsel" and M/V "Polarfangst", froze meat for human consumption on board. The conclusion of these trials is that they were technically successful for both preservation methods. Assuming that the products can be marketed at the prices expected, these methods aimed at solving the problem of utilizing seal carcasses will be practical and economically possible for the industry.



Sealing vessel on the grounds.

1. Introduction

As a result of a request from A/S Rieber & Co, Tromsø, on behalf of the sealing industry, it was decided in 1981 that FTFI should become involved in problems regarding the utilization of by- and waste products in the sealing industry. These problems have become especially acute since the Soviets have enacted a ban on dumping of seal carcasses in the East Ice. The ban has resulted in serious problems for the vessels in finding means of utilizing the seal carcasses.

Without an acceptable solution, the ultimate consequence is that the hunt in its traditional form may not be possible in the future.

The ban against dumping means in practice that the vessels must take on board the seals, skin them and then take care of skins, blubber and meat carcasses Without anything going back in the sea. It is of course theoretically possible that the seal carcasses be transported to the Norwegian or International zones to be dumped. However, in practice this cannot be carried out since it would mean frequent interruptions in the hunt and costly freighting that would definitely affect the total economic result.

Another alternative that has been tried for a couple of seasons is to store the carcasses in tanks onboard, cool them down with seawater and take them home. However, this presumes that there are markets for such raw material. In the instances where- this has been tried, the carcasses have been delivered to a rendering plant for around 0040 kroner/kg. However, there are no rendering plants in Northern Norway, and it would therefore not be a good alternative for local vessels. In addition, some of the carcasses will start to spoil underway so that the quality will be poor. This will also result in environmental problems for the crew onboard due to the air pollution resulting from the petrification process.

The correct solution would therefore be to preserve the seal carcasses onboard while they are still fresh. A profitable preservation method depends on finding uses for the product at an acceptable price. It is therefore obvious that as much as possible of the seal carcass should be

use d for human food. This would increase the value con si derabl y. After removal of the meat for human consumption, some offal such as intestines, bones and remaining meat and ligaments will remain. This offal must be considered to be animal feed and can be preserved with that use in mind. In order for the economics to be acceptable, these two methods of utilization must be considered together and preferably be carried out together.

In this project, which was started in the fall of 1981, it was decided that the usable meat should be frozen on the sealing grounds while the animal feed should be preserved with acid by the method developed by FTFI for fish and fish offal.

It was also-decided that equipment for acid preservation should be installed onboard one of the vessels and M/V "Kvitbjorn" belonging to A/S Rieber & Co, Tromsdalen, was chosen.

Equipment for freezing and cold storage of meat p. 3
was to be carried out onboard two vessels. M/V "Nordsel" belonging to Steinar Jakobsen, Tromsdalen, and M/V Polarfangst belonging to Paul Stark, Tromsø, were chosen.

Installation of the equipment was started at the end of 1981/beginning of 1982 on all vessels and was completed before the 1982 hunting season. The first part of "the project was carried out in the 1982 season,

2, Preservation of Seal Meat by Freezing on the Sealing Grounds.

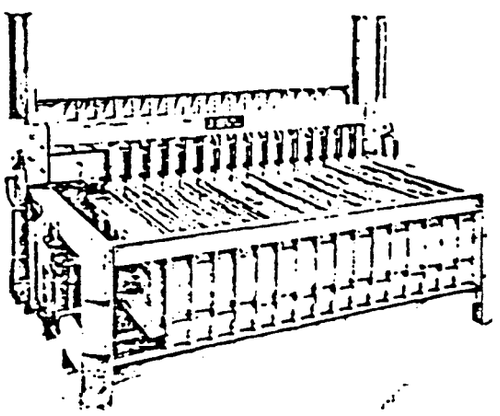
A vertical plate freezer of the Type Jackstone Freezer, 16 stations (plates) with average capacity of 216 kg frozen product per hour; i.e. ca. 5000 kg per day, was installed on each of the vessels. These plate freezers produce a block 1060 mm x 508 mm x 100 mm in size or a block weight of 50 kg meat. The freezers are also equipped with dividers that can halve the blocks.

The refrigeration machinery consists of a compressor with a capacity of 2000 kcal/hour at 35/+35.

The plate freezers were in both cases located under cover on the main deck under the forecastle.

There was already a cold storage room onboard M/S "Polarfangst" of ca. 1+(1 m^3 placed up front under the main deck. A corresponding cold storage was installed on board M/S "Nordsel". The refrigeration equipment consisted of a compressor with an output of 6000 kcal/hr.

Other extra equipment onboard consisted of bleeding tank and packing table with chute.



Vertical plate freezer

Hauling/hoisting seals onboard.

2.1 Description of hunt and processing. p. 5

When conditions permit, hunting is carried out by hunters going on the ice and shooting the seals. After some seals have been killed, the vessel follows and the seals are hoisted on board with the help of the winch and a long wire. At the end, the wire branches out to 6-8 shorter wire ends each ca. 2 metres long, and at the end of these there is a loop that can be slipped on and tightened around one of the back flippers of the seal. In this way, 6-8 seals

at a time can be hauled and hoisted onboard.

After the seal has been hoisted onboard, it is skinned i.e. the skin/blubber part is separated from the meaty carcass. The blubber is the fat depot of the seal and located in a 5-10 cm thick layer between skin and carcass. The skin/blubber part is washed and chilled down and then stored in the hold or in a tank. On shorter trips it is usually not necessary to carry out any form of preservation on this part of the catch. On somewhat longer trips it is, however, usual to treat the skin side with an antioxidant in order to prevent rancidity and thereby yellow discoloration of the skin.

p. 6

Skinning of seal.

Up to now, it has been this part of the catch that p.
has been of primary importance and the basis
for shares between owners and crew. Otherwise it has been
usual that the crew has saved some meat for their own use.
This meat has preferably been taken from young animals, i.e.
up to 2 years of age. Earlier it was mostly the front
flippers and the breast and back portions of very young
animals that were saved and salted in barrels. After some
vessels started to install small freezers onboard for
provisions, etc., some loin meat from young animals was
frozen for own use.

Some seal meat has therefore always been saved
for human consumption, and in typical "sealing districts",
especially the Tromso area, it has been an important
additional food source. People are used to this special type
of meat and appreciate it.

However, the quantities of meat saved have always
been a relatively small part of the total meat resource
available to this industry.

From the middle of the 1970's, after it became
possible to freeze meat onboard some vessels, there was
some interest in utilizing this raw material as an ingredient
in ground-meat products or for pure seal meat - or mixed
meat products.

As a trial arrangement, some meat was therefore
frozen on board a couple of the vessels over a 3-4 year
period. The meat was to be usedin trial production in the p.

meat packing industry, and it was mostly meat from adult animals. The products that were judged suitable for this special raw material was a salted and dried (smoked) sausage of the "Stabbur" type (a dark-colored sausage) (similar to "summer sausage", salami-type sausage. Transl. note) , canned seal meat, and meat-cakes in a special gravy (eaten with game in Norway and called "game gravy"). All the products were characterized as interesting and tasty.

On the basis of these trials it was concluded that there would be a possible market for this meat resource. The seal carcass itself comprises a relatively small part of the total weight of the seal. There will always be a certain variation since the thickness of the blubber will vary, but the usual estimate is that the carcass comprises ca. 50% of the gross weight. An adult seal weighing around 80 kg will therefore have a carcass weight of ca. 40 kg.

The percentage of meat that can be collected under field conditions will also vary. Experience shows that back meat and flippers can total 20% of a carcass, i.e., an adult seal will yield ca. 8 kg meat. Meat from the loin part of the seal is boneless; the flippers have bones.

As soon as the seals are skinned onboard the vessel, flippers and meat are removed immediately. The meat is p.9
kept in large containers (tanks) with running seawater. It is thereby chilled quickly and as much of the blood as possible is washed out.

The chilled and washed meat is moved to a table near the plate freezer where it is sorted so that meat and flippers are frozen separately.

After freezing, which takes 3 hours, the blocks are pushed out of the plates hydraulically. The blocks are moved to the packing table, wrapped in suitable packaging material and stored in the cold room at -25° C.

Situation on deck during the hunt.

2.2. Experiences

p. 10

In general, it can be said that experiences with this form of preservation of meat on the sealing grounds have been very good. About 40 tonnes frozen sealmeat was brought ashore after the 1982 season; 32 t from M/V "Nordsel" and 8 t from the M/V "Polar f angst". The second vessel had problems with the generator that supplied electric power to the refrigeration unit.

M/V Nordsel had a very successful trip, and both owner and crew were satisfied with the results. The routine onboard was carried out as earlier described and according to the skipper, Steinar Jakobsen, the time was utilized so effectively that the extra work reduced the regular free time only to a limited extent.

2.3 Evaluation of Capacity

In evaluating what capacity a plate freezer onboard should have, the following criteria were considered:

- Total quota per vessel ca. 5000 animals (In 1983 the quota was 4500 animals per vessel)
- Minimum 10 days hunting period

With a meat yield of ca. 8 kg per animal, total yield of meat would be 40,000 kg in 10 days; i.e. an average of 4000 kg per day.

Based on these calculations it was decided to install a plate freezer with a capacity of 5000 kg per day which should give an over-capacity of 25%. With this capacity it should be possible to freeze meat from 62o animals per day.

In actual practice it is unlikely that a higher number of animals would be taken in a day. But in cases when this would occur, the excess meat would keep for freezing the next day due to favorable climatic conditions. On this basis and with today's quotas, a freezer with a capacity of 5000 kg per day is considered to be of a reasonable size.

2.4 Packaging

After freezing, the meat blocks were packaged and taken to the cold storage. Sturdy plastic bags from Polar Plast & Papirindustri A/S, Rognan, were chosen as packaging material.

The raw material of the bags was of the type Uni fos Polyten DFDS - 6600 pigmented black and approved for contact with foods.

The bags had the following measurements:

600/50/50 x 700 mm.

Plastic thickness 100 micron designed for packaging 25 kg blocks.

After the blocks of meat were packed in the bags, these were closed with sturdy plastic tape. Labelling of the various meat qualities (loin meat, flippers) was done with different colored tapes.

2.4.1 Experience with packaging material

p. :

By inquiring at the processing plants that have received the raw material, reactions have in general been positive to this packaging method.

It was pointed out as positive that the packages were air-tight which should prevent dehydration and development of rancidity during storage. Some felt that it would be desirable to use a carton in addition to the plastic bag in order to increase package strength. Plastic bags alone can also be rather slippery to handle.

However, practical considerations dictate that the use of cartons onboard would be too time-consuming and expensive. It is therefore concluded that the packaging material used in the trials would be acceptable.

2.5 Sanitary Considerations and Guidelines

Guidelines for slaughtering seals onboard vessels have been issued earlier and are included as an appendix. These guidelines were given to the vessels before departure.

It should also be noted that large quantities of clean seawater is continuously poured over skins, blubber and meat during operations on deck, keeping the area clean, and to prevent slippery surfaces. The meat is chilled in bleeding tanks and the cool environment is not conducive to microbial growth. Sanitary standards can therefore be maintained at a fully acceptable level.

2.6 Evaluation of Seal meat as raw material.

In spite of the special conditions on the sealing grounds, it is possible to carry out slaughtering and packaging operations according to the regulations. It is therefore possible to achieve a high sanitary standard for the meat. The meat is handled when fresh and quickly frozen so that any microbial activity is low.

According to the regulations, bleeding must be carried out as quickly as possible after death. The animals are

killed by shooting through the head using lead-tipped bullets and telescopic sights. Some blood will then usually pour out through the bullet hole. As soon as possible after shooting, the seal is hoisted onboard and skinned or cut open and partly skinned on the ice. The jugular arteries are often cut during skinning and in any case the arteries going to the front flippers as these are removed. Some p. blood will also run out during these operations and also when meat and flippers are placed in running water. Even so, sealmeat must be characterized as dark and with a high blood content. However, this is a characteristic of seal meat that cannot be altered regardless of how bleeding is carried out on the sealing grounds.

2.6.1 Chemical composition

Some analytical results from chemical analyses of seal meat and meat products are given in the appendix. Some opinions after testing the products in laboratories and results of taste panels are also given.

2.6.2 Product properties of the meat.

Seal meat is characterized as somewhat coarse in texture, very tender and dark meat with a characteristic gamey taste. It has been tried as an ingredient in blended products and as raw material for new products at three different meat packing plants in Southern Norway. Reports

from two of these and laboratory results from the third are included in the appendix.

Trondheim Preserving (canning) Co. Ltd tried seal meat as an ingredient in minced products (meat cakes, etc) and as raw material for canned seal meat in wild game gravy. According to spokesmen for the company, the meat is well suited for these products) and impartial taste tests give the products good marks and recommendations.

However, the plant people say that the meat is somewhat labor-intensive, but that the quality has been very satisfactory.

Nora Food Products Ltd tried seal meat both from loin and flippers as ingredientsin cured sausages of the Stabbur type (Hedmark sausage) .
Their finding was that after storage for some time, an off-flavor described as soapy developed. The cause of this flavor is ascribed by the company to rancidity of the fat. This is the direct reason that the production of this product ceased. This company therefore concludes that seal meat is not suitable for use in cured products that may be stored for longer periods due to the rancid off-flavors.
So far they have no experience with seal meat for short-term storage or with sterilized products but believe the meat is more suitable for this (see appendix).

Bjornebraten Sausage CO. Ltd, Hemsedal, has made cured sausages (Stabbur type) with seal meat from flippers and loin as ingredients. Their comments are that seal meat is a suitable raw material for these products (see appendix).

2.7 Economics

The total investment per vessel was originally estimated to be kr. 5509000 .- as follows: p. 16

Enlarging cold storage	kr 100,000
Plate freezer w/refrigeration machinery	" 394,000
Alterations to hull	" 25,000
Unforeseen charges	" 31,000
Total	kr. 550$000

The actual costs were exceeded on both vessels, a total of ca. 200$000 kroner for each. The equipment costs were as estimated while the changes to the vessel and upgrading of existing facilities turned out to be much more extensive than first estimated.

Total investments for the two vessels were therefore:

M/V "Nordsel" - kr 769.685.55

M/V '~ Polarfangst"- kr 736,908.50

It was mentioned earlier that there was a technical fault on board M/V "Polarfangst" early in the season which resulted in the equipment being out of commission. The results from this vessel are therefore disregarded and only those from M/V "Nordsel" considered in this report.

2.7.1 Total Catch and economic results p. 1

In the 1982 sealing season a total of 7000 animals

were taken by M/V "Nordsel". These were mostly adult harp seals. The following extra income was generated from these:

Loin (back) meat (plate frozen)	24,258 kg at kr 14. -/kg	=kr 339,612.-
Flippers (plate frozen)	7,628 kg at kr 8.-/kg	=kr 61,024.-
Total	31,886 kg	kr 400,636 .-
Crew share 39.2%		kr 157,049.-
To vessel owners		kr 243,587.-

Extra crew share (14 man *crew)*

$$\frac{\text{kr } 400{,}636 \times 2.8}{100} = \text{kr. } 11{,}217.-$$

Due to space restrictions onboard, only a part Of the flippers were taken careof. The total quantity of meat could therefore have been considerably greater, if the whole meat resource could have been utilized.

2.7.2 Profitability for vessel owners p. 18

The depreciation period is taken as 7 years and the interest 10%. This gives an annuity factor of 0.205. (All numbers rounded off to the nearest 1000).

Gross profit		kr. 244,000.-
Variable costs:		
Packaging material and freezing costs (30 ore per kg)	kr. 10,000.-	
Maintenance (3% of equipment investment)	kr. 15,000.-	25,000.-

Contribution	kr. 219.000 .-
Fixed costs:	
Capital costs (kr 769,685 x 0.205)	kr. 158,000 .-
Average yearly net profit	kr. 61,000 .-

The estimated result is based on an extra income of kr. 244,000 per year. The final result will of course depend on price and market conditions for seal neat in coming years.

The result will also to a certain extent depend on the capital costs. This will again mean the depreciation period chosen.

If an annuity factor of 0.315 is used, i.e. 4 years depreciation and 10% interest, the results will be approximately in balance. This means that the equipment can be written off in 4 years without the results being negative. It must also be considered that considerable public assistance was given for these installations which in this case will lower capital costs. The results are therefore somewhat better for M/S "Nordsel" than pictured here. p. 19

Other fixed costs, such as food and living costs onboard are not included in the estimate since these would be unchanged in all cases.

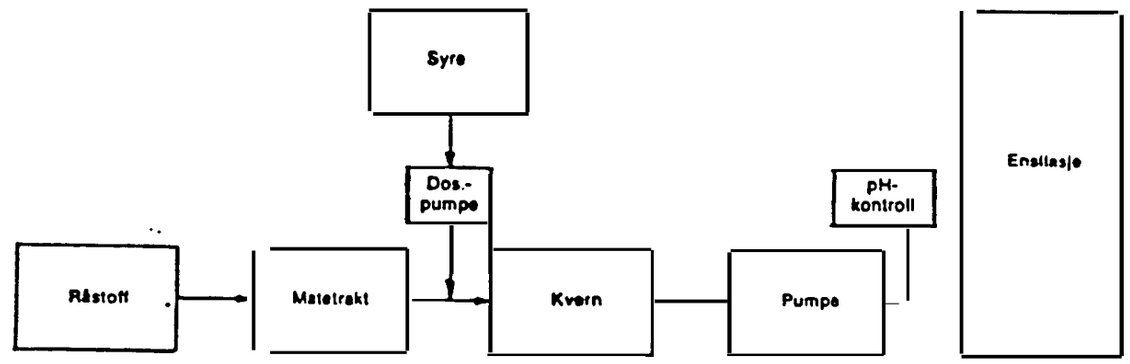
Maintenance costs have been calculated as 3% of the investment costs of the technical equipment which came to a total of ca. 500$000 kroner.

2.7.3 Results with 35% Government support.

Gross profit	kr.	244,000.-
Variable costs	"	25$000.-
Contribution	kr.	219,000.-
Fixed costs		
Capital costs (kr. X0,296 x 0.205)	"	103,000.-
Result	kr.	116,000.-

3. Acid Preservation of Seal Carcasses (Silage) p. 2C

This preservation method consists of increasing the acidity (reduce the pH value) to a level where the activity of micro organisms is reduced to a level whereby the product will not spoil. This can be done by several methods, but commonly acid is added directly to the mass to make it more acidic. In agriculture it is common practice to acid-preserve grass by adding formic acid. This preservation method is now becoming more commonly used in the fishing industry where silage is being produced from fish offal for use as feedin the fish farming and fur industry. A fully automatic system has been developed at FTFI for producing silage from fish and fish offal both onboard vessels and ashore. These systems have now been in operation over a period of 3-4 years with reasonably good results.



Raw Material | Feed Chute | Acid Metering Pump | Grinder | Pump | pH Control | Silage

Fig. 1. Flow sheet of silage process.

It was therefore natural to "think" silage in connection with the utilization of seal offal. Equipment for producing silage from fish on a fishing vessel, in addition to equipment for grinding up whole seal carcasses was installed onboard M/V "Kvitbjørn". Successful trials were carried out in the 1982 and 1983 sealing seasons. p. 2

3.1 Description of the equipment

In principle, acid preservation consists of grinding up the offal, adding the correct amounts of acid and mixing well. The mass can then be stored in a tank over a longer period of time. From a microbial point of view, the keeping time is almost unlimited. However, some chemical changes such as rancidity can occur. This can to a certain extent

be prevented by adding antioxidants.

For the acid preservation of seal carcasses, a fully automatic silage installation o f the type Hamj ern 6E was install ed onboard M/V "Kvitbjorn". The equipment has a capacity of ca. 8000 kg/hr when used to preserve capelin.

The following illustration outlines the operation of the system.

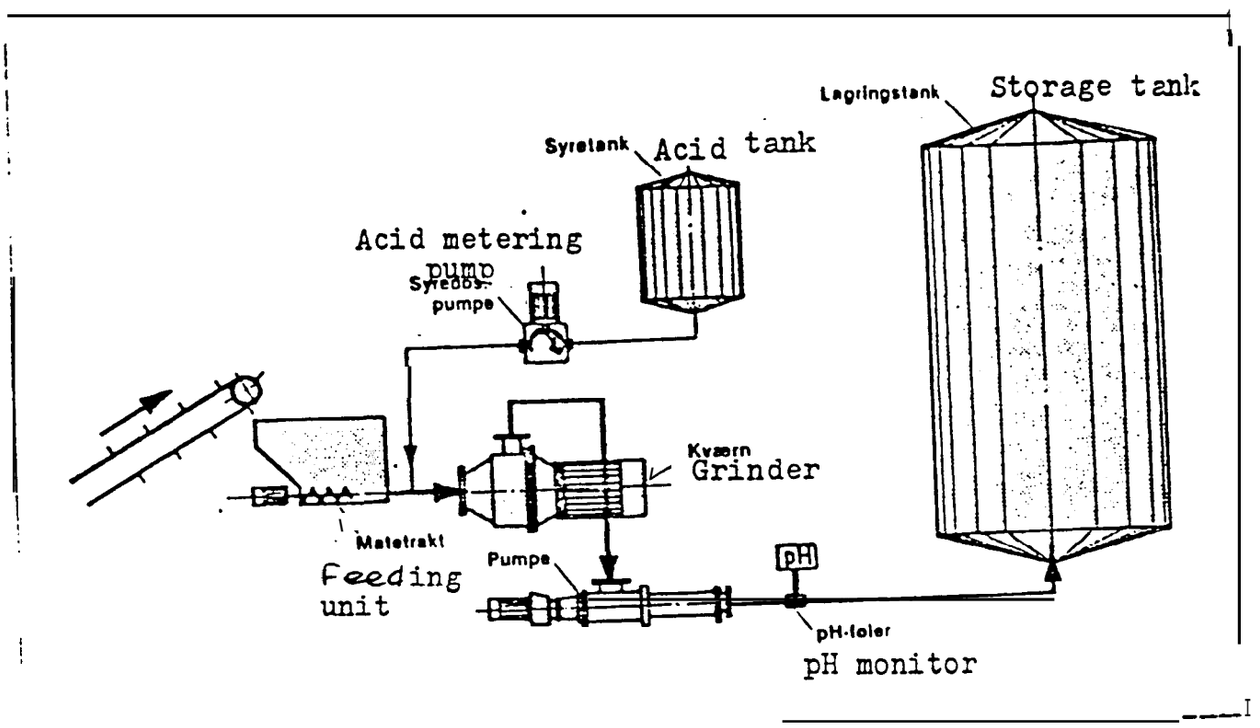


Fig. 2. Sil age

p. 22

The raw material is brought to the feeding unit from where it is fed into the grinder by screws on the bottom on the feeding chute and partly by the processing pump that sucks the mass from the feeding chute through the grinder. The acid is added to the mass by an adjustable

metering pump before it enters the grinder. The acid is therefore well mixed during grinding and subsequent pumping and is then preserved for storage. The product pump then transports the finished silage to a storage tank via a pH control unit which continuously registers the acidity of the mass. If the pH falls outside the desired range, an alarm in the form of a light or sound is triggered so that the necessary adjustment of the acid-metering pump can be carried out.

p. 2

The process is continuous and fully automatic and is controlled by the help of microswitches, time relays and capacitive sensors.

3.1.1 Additional equipment for acid Preservation of material containing bones.

In the acid preservation of bone-containing and non-pumpable material, it is necessary to grind up the material before making the silage. This can be done by locating an ordinary grinder so that the ground mass goes directly into the feeding chute of the silage equipment. Another alternative, which was also tried, is to make a special feeding chute with more effective screw transport.

3.1.2 Special equipment for cutting up seal carcasses

In order to cut up whole seal carcasses it is necessary to have special equipment.

For this purpose a "blubber-chopper"

("spekk-hogger") was installed for our trials. This equipment was especially constructed by A/S Rieber & Co., Tromso, and was earlier used to cut up blubber.

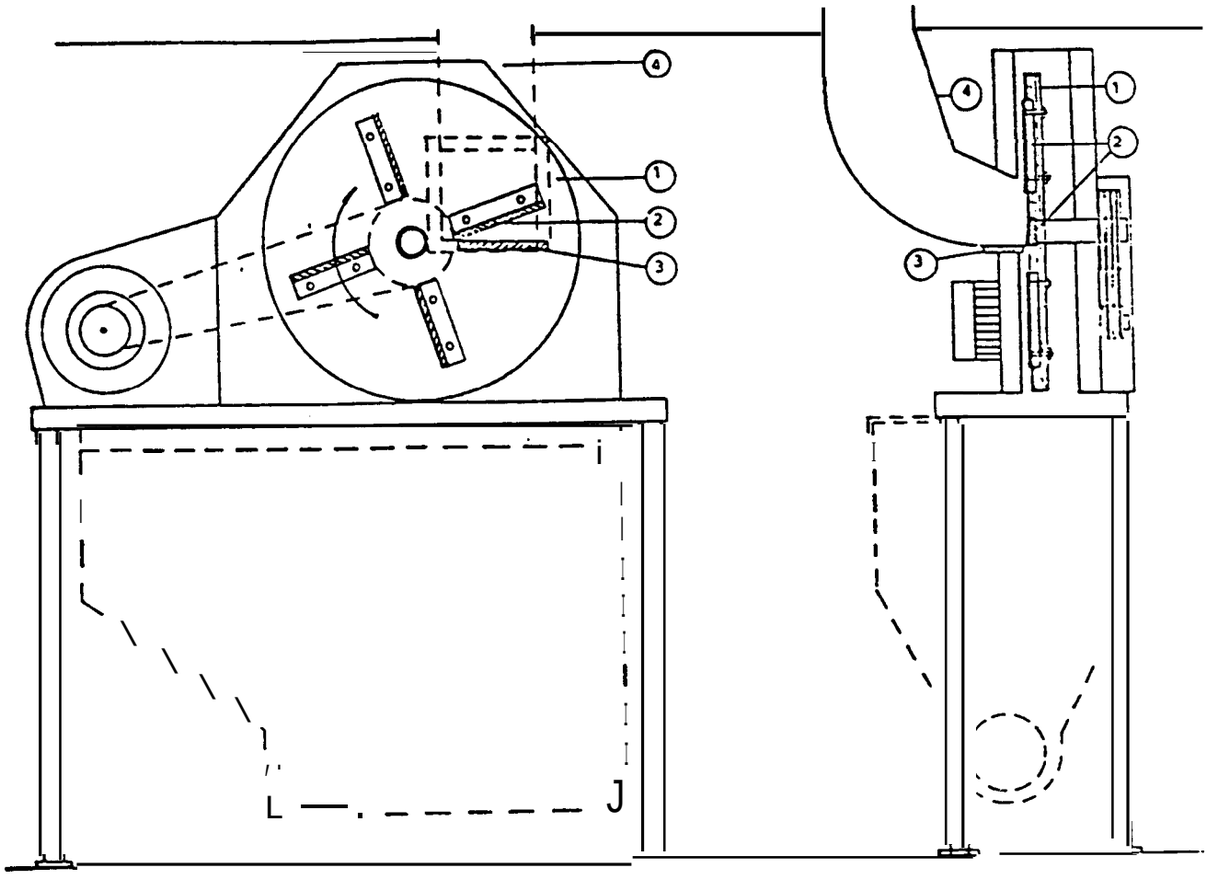


Fig. 3. Spekkhogger (" Blubber- chopper") p. 24

1. Massive, rotating disc
2. Knives
3. Counter knife
4. Feeding pipe

The construction and working of the chopper can be described as follows:

The main part consists of a massive rotating disc with a diameter of ca. 1.5 m, thickness ca. 40 mm. Radially in the disc there are 4 knives of special hard steel at 90^{o} relative to each other. A fifth knife of the same quality (counter knife) is fastened to the frame and placed so that a scissor is formed every time the knives pass the counter knife.

The chopper and the other silage equipment is placed on the main deck under the shelter deck. During hunting, all work is carried out on the shelter deck.

The seal. carcasses are cut (clipped) up by being fed axially against the knife wheel, from the shelter deck through a curved, square pipe.

From the chopper the mass is fed directly to the chute of the silage equipment and fed continuously through this to the storage tank for silage as earlier described.

3.2 Implementation

The original plan called for the production of ca. 70 m^3 silage. Based on this, an acid tank with a volume of about 1800 litres was installed onboard. A storage tank for silage with about the same volume was also readied onboard.

The daily routine was carried out so that the carcasses were made into silage while absolutely fresh. This means that the seals were skinned immediately after landing on deck, usable meat removed and the carcass sent to the silage plant until the planned quantity of silage has been produced.

The preservative used was a mixture of formic and propionic acids (commercial grade) in 5:1 ratio. In addition, an antioxidant (ethoxyquin) was added in a ratio of ca. 10 Lper 1000 L acid. This will correspond to a concentration in the silage of ca. 200 ppm.

About 2.5% preservative acid was added to the mass, and this amount brought the pH down to ca. 4.0. After a day or so, the pH had stabilized at 4.3-4.4.

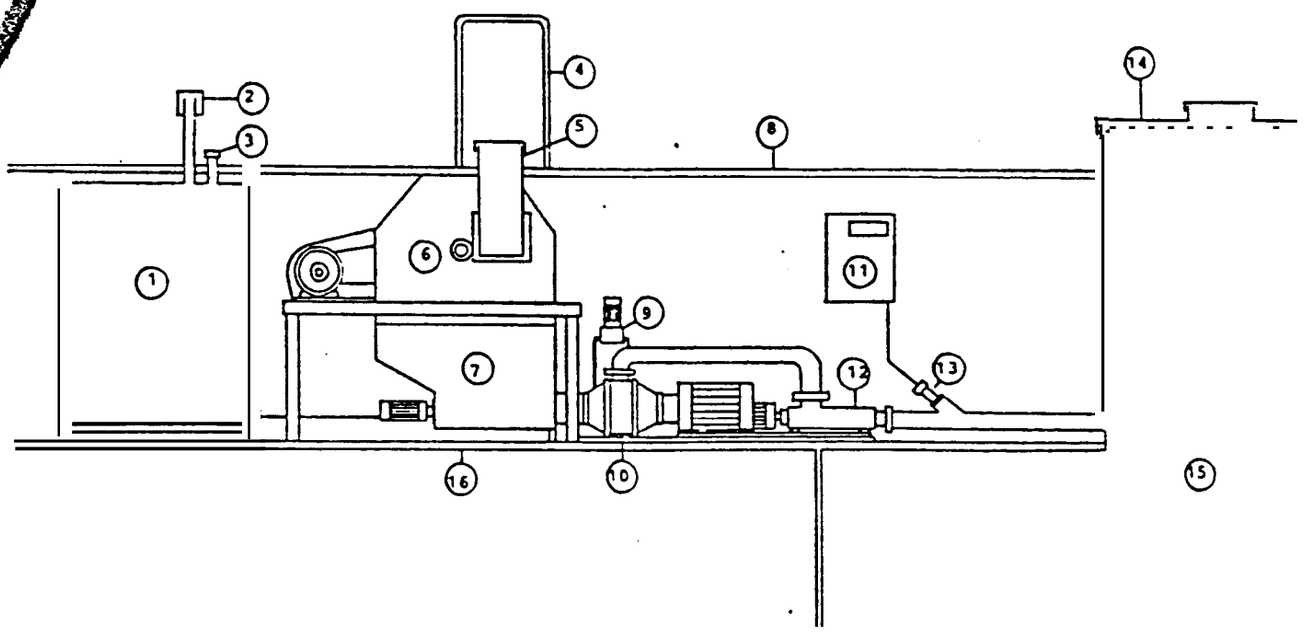


Fig 4. Sketch of silage equipment for seal carcasses. p. 27

1. Acid tank
2. Vent
3. Filling pipe
4. Protection
5. Feeding chute for carcasses
6. Chopper
7. Feeding chute
8. Shelter deck
9. Acid metering pump
10. Grinder
11. Electric panel
12. Product pump
13. pH control
14. Tank hatch
15. Tank
16. Main deck

3.3 Practical experiences

In general, it can be stated that the processing equipment worked satisfactorily and that the way the components were arranged was practical. The chopper worked fine, and the carcass of an adult seal was chopped up in 3-4 seconds. A piece of equipment like this can be very dangerous, and protective railings and edges were installed around the inlet on the shelter deck.

The chopper cut the carcasses so that the mass could be characterized as pumpable when it entered the feeding chute. The knives proved to be very durable and during the whole sealing season (4500 animals) it was not necessary to change or sharpen the knives. Silage production beyond this time would, however, have required exchange or sharpening of knives in the chopper.

The silage equipment also worked satisfactorily after some adjustments and rebuilding.

The first trials in the 1982 season were therefore only partly sucessful in that unexpected events occurred. The silage equipment was then set up as for processing fish silage, f. inst., the acid-metering inlet was placed in the inlet to the grinder. As the acid was added, the mass solidified so quickly that the product pump could not manage to suck it up and pump it further. A change was therefore made here so that the acid was added justbefore the pump. After this the equipment performed well. However, the rather solid mass could not be forced through the feed

pipe to the storage tank. This pipe had a 3" diameter and was installed with four 90° elbows over a total length of ca. 8 m. For that reason the experiment had to be given up in the 1982 season. By separating the feeder line from the silage equipment it was still possible to produce enough silage to carry out the planned studies (feeding experiments, storage experiments, chemical and bacteriological analyses, trichinosis analyses, etc.). p. 2

Before the sealing season 1983, some minor adjustments were made to the equipment, and the feeder line from the silage equipment to the storage tank was changed. The diameter was changed to 6 inches, and the feeder pipe was led in a straight line to the storage tank. In addition, an extra pump of the type Lobe GP400 4" autodrive, stepless (75-300 r.p.m.) was installed after the product pump.

Since the acid-metering pump had to be located between grinder and pump, the acid mixing was somewhat poorer than desired, and it was assumed that an extra pump would assist and also help to get the mass pressed into the storage tank.

After these changes the equipment worked satisfactorily with an estimated capacity of over 5000 kg per hour. It can in any case be stated that the equipment could handle the catch on the best days when close to 1000 animals were processed.

The automatic system worked well and except for a few small problems with the float for the micro switch which

signals automatic start , the system functioned normally. The above mentioned problem occurred because the float, which was located in the feeder chute, at times was loaded down by the mass from the chopper and the micro-switch was therefore not activated. However, this was corrected by placing a screen over the float. The acid metering was reliable and the equipment could operate for long periods without attention.

3.3.1 Future technical modifications

p. 30

Even if the equipment worked satisfactorily in the 1983 season, certain items were noted that could be further improved.

The most important was the acid admixture. Since the acid metering system had to be moved from the inlet of the grinder to the pump inlet, the mixing effect was not completely satisfactory even after pump No. 2 had been installed. For that reason, a minor over-addition of acid had to be carried out in order to get an acceptable preservation.

In order to correct this, two solutions can be considered:

Alternative 1: Pump No. 2 is removed and a mixing unit is installed instead, for example a grinder (macerator) similar to the one in the silage equipment. Acid-metering point is moved to the front of this. Thereby there will be an effective admixture of the acid when the mass passy through

the macerator.

Alternative 2: A more reasonable and probably satisfactory solution will be achieved by exchanging the components in the silage system so that the product pump is placed in front of the grinder, and the acid metering point is placed between these. Thereby the grinder and the acid metering will be on the pressure side of the pump which will mean more power to get the silage transported through the grinder.

This can probably be carried out since the mass after the chopper appears to be pumpable.

. Actual utilization of the product

p. 31

The original intention was to utilize the acid-preserved seal product as feed for fur animals. The trial was for that reason coordinated closely with the Norwegian Fur Animal Farmers Assoc., Norwegian Agricultural College, and the Veterinary Institute.

Contact were also made with, and samples sent to, producers of dog and cat food.

No trials have yet been made with use of the product in the fish farming industry. Earlier trials with the use of offal from slaughterhouses and with acid-preserved fish and fish offal have given good results in this industry. It is therefore reasonable to assume that this type of raw material (from seals) can also be used, For that reason preparations should be made to carry out feeding experiments with trout and salmon in the 1984 season.

Based on the above mentioned plans in the fur-animal and pet-food sectors, the product from the two sealing seasons was utilized as follows:

In the 1982 season about 800 kg of silage was produced, and out of this, ca. 500 kg was sent to the Norwegian Agricultural College for feeding trials with mink. Ca. 100 kg was sent to two different pet-food producers for sample production and evaluation. The remaining 200 kg went as samples to local dog associations etc.

In addition, necessary samples were removed for various analyses and studies at FTFI, Norwegian Fur Animal Breeders Assoc. and the Veterinary Institute.

The samples were partly taken out during production on the sealing grounds and partly after the end of the season. A small quantity was also stored to test the storage ability.

p.

In the 1983 season the total quantity was 65, 000 kg silage. After various samples had been removed the silage was distributed to three large fur animal feed kitchens. Two of these were in the county of Sunnmore, and the silage was transported there with a sealing vessel from Western Norway.

The third feed kitchen is in Vesteralen where the kitchen's own tank trucks were used for the transport from Tromso to Vesteralen.

Unloading and loading from boat to boat, from boat to tank ashore and from tank to truck was carried out without problems with a pump of the eccentric screw type. In all

cases a pump of type Nemo 60 with a capacity of 10-12,000 kg per hour was used. This is a relatively small pump, and the loading and unloading capacity could easily be increased by the use of a pump of the same type with greater capacity.

.5 Preliminary studies

Before a decision was made to start the project) some preliminary studies and trials were carried out at FTFI in order to get a picture o f the chemical composition of the seal carcass and the keeping time by acid preservation. Flippers of seal. that had been kept in frozen storage since the 1981 season were used for this purpose.

The flippers were ground up and acid preserved with an acid mixture consisting of equal amounts of concentrated formic and propionic acids , with admixtures ranging from 1 to 3%.

Five different samples were kept in storage over p. 3 a five month period at room temperature. A chemical analysis of the composition of the silage was also carried out*

3.5.1 Storage tests

pH values on storage with different acid concentrations:

Dato	1% maur-propionsyre	1,5% maur-propionsyre	2\ maur-propionsyre	"2,5% maur-propionsyre	3% maur propionsyre
10/9	4,88	4,58	4,39	4,24	4,08
11/9	5,08	4,77	4,67	4,45	4,35
17/9	5,22	4,93	4,7s	4,57	4,46
29/9	5,33	4,88	4,77	4,59	4,48
6/10	5,42	4,97	4,80	4,60	4,52
6/11	5,59	5,16	4,74	4,60	4,50
8/12	5,76	5,29	4,97	4,69	4,50
7/1	5,74	5,26	4,90	4,61	4,48
5/2	5,83	5,35	4,96	4,65	4,51
10/3	5,83	5,35	4,93	4,61	4,47

Date/1% formic/
propionic acid

From the results of this test it was decided to carry out acid preservation by adding 2.5% acid. The results show that even with only 1% acid added the silage kept well. Even if the pH value gradually increased to pH5.83, there was no indication from the appearance or the odor that the mass was going putrid.

3.5.2 Chemical composition

p. 34

Dry matter	-	38.8%
Ash		4.7%
Protein	-	19.8%
Fat	-	14.3%
F.F.A.	-	27.7%

The chemical composition of the material from the preliminary trials shows somewhat higher fat content than later analyses showed. This is due to the fact that the

flippers have considerably more fat than the cross section of a skinned carcass. The problems that followed in the field trials with the rapid thickening of the mass the moment the acid was added were not noted in the introductory silage experiments on a laboratory scale.

The difference between the two types of raw material was that the raw material in the preliminary trials had been frozen. This difference could possibly have caused the difference in behavior when acid was added.

3.6 Product Properties

p. 35

3.6.1 Silage texture

As mentioned, one of the problems in the starting phase was that the raw material practically solidified during the silage process.

The reason for this has not been studied more closely. However, it is known that acid preservation of blood causes the blood to solidify to a considerable extent. Such coagulation also occurs in the seal meat, probably primarily due to the high blood content.

The texture could be characterized as very firm and similar to blood sausage.

There was therefore some uncertainty as to how this silage should be unloaded and transported further. However, it was assumed that the mass would liquify somewhat during storage due to enzymatic activity (autolysis) since the

temperature in the silage was kept at +30°C. This relatively high temperature was chiefly caused by the body temperature of the seals when slaughtered.

These assumptions were confirmed during unloading after the 1983 season. The firm silage had dissolved to a pumpable mass with a texture like thin porridge.

3.6.2 Analyses of products from the sealing grounds p. 36

During both sealing seasons, a number of samples were taken at different times for chemical and bacteriological analyses, trichinosis studies, storage tests and feeding trials.

Chemical analyses were carried out at FTFI, Norwegian Fur Animal Breeders Assoc. (NPL) and Norwegian Agricultural College (NLH).

Bacteriological studies were carried out at the Norwegian Fur Animal Breeders Assoc. (NPL).

Trichinosis studies were carried out at the Norwegian Institute for Food Sanitation at the Norwegian Veterinary College and the Food Control Laboratory in Harstad.

The feeding experiments were carried out at the Norwegian Agricultural College.

Storage tests were carried out at FTFI and the Norwegian Fur Animal Breeders Assoc. on pH levels, through bacteriological analyses and sensory evaluations.

3.6.3 Results of chemical-and bacteriological analyses p. 37

The analytical results obtained by the Norwegian Fur Breeders Assoc are listed in the Appendix. The chemical analyses on the composition of the silage gave the following results:

Dry matter: 35.2%
Ash 4.5%
Crude protein 22.4%
Crude fat 6.4%
pH 4.19% (?/should not be %, Transl. note)

The bacteriological studies showed a very low total plate count compared with other ingredients used in feeds for fur animals as shown in the results on pgs. 55-58 (in original). The results were throughout as follows :

	Newly Produced	Stored
Total count per gram	20,000	560,000
Coliform per gram	10	10
Fungi per gram	100	100

These results were from this season's samples and show a relatively large increase in total count between fresh and stored silage in contrast to the results from the first season which showed little or no increase in the total bacterial count.

The reason for the sharp increase could be due to the acid being somewhat poorly distributed in the mass through the two pumps in the silageequipment and that there could have been pockets formed that had pH values that were p. 38

too high.

It is therefore necessary that the equipment be rebuilt according to one of the before mentioned suggestions for next season.

3.6.4 Trichinosis investigations

Due to uncertainties about whether seal meat could represent any danger for trichinosis infection of mink, studies were also undertaken in this area. Thirty-gram samples were taken from 500 seal carcasses during the 1982 season for this purpose. The samples were frozen onboard. After the end of the season the samples were sent to the Food and Control Laboratory in Harstad for analyses and the results are given on p. 62 in original.

Conclusion: No presence of trichinae was demonstrated in the 500 samples.

At the Institute for Nutritional Health, Norwegian Veterinary College, studies were carried out with respect to the survival rate of trichinae in seal meat silage.

The experiment was carried out in two parts. Experiment I was carried out by making silage from trichinae-infected mouse meat, and experiment II by mixing trichinae infected mouse meat with non-infected seal meat before making the silage.

A report on this experiment is attached in the Appendix.

Conclusion: The structure and infective properties of trichinae are destroyed by silage.

3.6.5 Storage tests

The storage tests carried out at NLH, FTFI and Norwegian Fur Breeders Association have shown that silage from seal carcasses has a very long keeping time. Stable pH values were registered over a period of one year, and no negative sensory effects were registered over the same period. Bacteriological studies have also shown that the storage ability is very good and that very few changes in the total bacterial count have occurred.

Chemical decomposition can to a certain degree be prevented in that antioxidants can be added in order to reduce fat rancidity.

Norwegian Agricultural College Scientists determined that the silage had satisfactory feed value over a period of at least one year when stored at room temperature.

During storage the mass will break down due to enzyme activity, autolysis. This means that the silage will become somewhat more liquid with time (very temperature dependent). This can have a certain importance for the texture (consistency) of the finished feed mixture. But there is no nutritional reduction associated with this.

3.6.6 Feeding experiments

All feeding experiments on mink have been carried out at NLH. The experiments started after the 1982 sealing season in the month of July and continued over a l-year period and included chemical analyses, digestion experiments

and production experiments through all phases of the mink life cycle.

A report *on* these experiments, carried out by researcher Anders Skrede, Institute for Poultry and Fur Animals, is available. p. 40

The results from the chemical analyses and digestion experiments show that the seal silage contained 19% digestible protein and 5.3% digestible fat. Based on the combined fat/protein value, 100 kg seal offal silage will be equivalent to 122 kg fish offal. plus 28 kg slaughter offal of usual qualities.

The conclusion of the production trials was as follows:

The long term feeding trials extended over a full year and all stages of the life cycle of the mink. Therefore, quite definite conclusions were reached on the use of this type of silage from seal offal for up to ca. 12% of the feed. It is completely obvious that the use of seal offal silage has not resulted in any negative reactions in the animals. Both health, reproduction, growth and fur quality has been fully equal to the results in the control groups. For several properties there were indications of positive effects from the silage. These include growth, skin size, skin color and reproduction.

On the basis of these trials, it can be concluded that silage from seal carcasses seems to be a well-suited feed for fur animals.

3.6.7 Other Planned uses

The planned uses of this product as an ingredient in cat and dog foods were not investigated. Two Norwegian pet food manufacturers were contacted and samples sent. So far there has been no reaction.

However, some scattered trials were. carried out on feeding pure seal silage to dogs. For example, a dog club in Tromso has tried pure silage as dog food and according to their reports, the dogs ate the silage with good appetite. However, there is no information available on long-term effects of such feeding.

.7 Economics

An economic evaluation of this project will, if viewed separately, largely result in negative economic results. It is therefore necessary to consider, acid preservation onboard a sealing vessel in connection with utilization of the meat for human consumption, so that a collective economic evaluation is used as basis for future activity in this area.

3.7.1 Investment costs

Based on the experiences with the installation of equipment for producing silage onboard M/V Kvitbjorn)the following items can be set up on the investment side (numbers rounded off to the nearest thousand) :

Complete silage equipment incl. installation:	kr. 268,000 .-
Coarse chopper incl. installation:	64,000 .-
Various electric installations:	30,000.-
Unloading pump:	34,000.-
Various other expenses:	28,000.-
Total investments:	kr. 424,000.-

. .2 Catch Volume and economic result

F. 42

The quota for the 1983 season was 18,000 animals in total*

Distributed over 4 vessels, this means 4,500 animals per vessel.

Silage yield per vessel: 32 kg x 4500 = 144,000 kg.

Value:

According to the nutritional value from feeding experiments and calculations at NLH, 1 kg of seal silage will have the same value as 1.22 kg fish offal + 0.28 kg slaughter offal.

According to information on market prices of these feed types at N.P. A/L, this will give the following economic value of the seal silage:

The prices are CIF, delivered to the nearest slaughter house or wharf or feed kitchen.

1.22 kg frozen fish offal at kr. 0.90 per kg (filleting offal)	kr. 1.10
0.28 kg slaughter offal at kr. 1.15 + freezing costs kr. 0.22/kg	kr. 0.38
Price per kg seal silage	kr. 1.48

Gross catch value kr. 1.48 x 144,000		kr. 213,120. -
Crew share 2.8% (14 man crew)		83,540 .-
Vessel *owner* share		kr. 129,580.-
Extra share per man: $\frac{\text{kr. } 213,120 \times 2.8}{100}$		kr. 5,967.-

P. L

3.7.3 Profitability calculations

The following assumptions were made:

The offal from the whole catch quota is made into silage.

Product price is kr. 1.48/kg delivered to the ~~port~~ wharf closest to a fur animal feed kitchen.

Depreciation period and interest on "loan : 7 years and 10% which gives an annuity factor of 0.205.

All values are rounded to nearest 1000 kroner:

Gross profit:		kr. 130,000.-
Variable costs:		
Maintenance (3% of equipment inventory)	kr. 13,000	
Acid costs (4.000 l at kr. 4.50 per l)	kr. 18,000	
Energy costs	kr. 3,000	
Freight costs (kr. 0.25 per kg.)	kr. 36,000	kr. 70,000.-
Contribution		kr. 60,000.-
Fixed costs:		
Capital costs (kr. 424,000 x 0. 205)		kr. 87,000.-
Net result:		kr. 27,000 .-

3.7.4 Comments profitability calculations p. 4.

The calculations show that there will be a deficit of kr. 27,000 with the assumptions made. If it is assumed that public support of up to 35% of the investment costs is given for installation of silage facilities onboard, the result will be as follows:

Gross income:	kr. 130,000
Variable costs:	70,000
Contribution:	kr. 60,000
Fixed costs:	
Capital costs	
(kr. 2'76,000 x 0.205) =	kr. 57,000
Net result:	kr. 3,000

However, it should also be noted that equipment for producing silage onboard a sealing vessel can also be used for making silage from fish and fish offal which today is easily marketable in the fish farming industry. Most of the vessels also carry out various fishing operations which makes it possible to utilize such equipment on other fishing grounds. It can therefore reasonably be assumed that the installation of equipment for producing silage can give a satisfactory economic result.

4. Overall Ecomonic Considerations

4.1 Investment costs

If it is assumed that each sealing vessel installs

equipment both for freezing o f meat for human consumption and for producing silage from o f f al , the economic result will be as follows:

It is assumed that a new generator will be installed on board in order to supply the increased demand for power.

Investment costs:

Equipment for freezing and cold storage	kr. 770,000.-
Equipment for producing silage	kr. 424,000.-
Generator	kr. 80,000.-
Total investment	kr. 1,274,000.-

401.1 Total catch and economic yield

Back (loin) meat	(18,000 kg at 14 kr/kg)	kr. 252,000.-
Flippers	(18,000 kg at 8 kr/kg)	kr. 144,000.- ,
Silage	(144,000 " 1.48 /kg)	kr. 213,120.-
Gross increased catch value		kr. 609,000.-
Crew share (2.8% - 14 men)		kr. 238,728.-
Vessel owner share		kr. 370,272.-
Extra share per man		kr. 17,052 .-

4.1.2 Profitability calculations P. 46

(All numbers rounded to nearest 1000)

Gross profit kr. 370,000.-

Variable costs:

Freezing plant share kr. 25,000.-

Silage equipment share kr. 70,000.-	kr. 95,000.-
Contribution	kr.275,000.-
Fixed costs:	
Capital costs (kr. 1,274,000 X 0.205)	kr.261,000.-
Net result:	kr. 14,000.-

4.1.3 Result with 35% public support

Gross profit	kr. 270,000.-
Variable costs	kr. 95,000 .-
Contribution	kr. 275,000.-
Fixed costs	
Capital costs (kr. 828,000 X 0.205)	kr. 169,000.-
Net result	kr. 106,000.-

4.1.4 Total profit for the sealing industry

For the total sealing industry in the East Ice, the meat and offal products will represent a total increase of kr. 2,436,000 in first-hand value.

Assuming that the traditional catch value per vessel is 1.2 mill kroner under present conditions, this would, for this year correspond to the following total catch value for products from the East Ice :

Traditional catch value: 1.2 mill kr x 4	= 4.8 mill kroner
Assumed value of meat/silage	= 2.4 mill kroner
Total catch value	7.2 mill kroner

Total increase in value: $\frac{2.4 \times 100}{4.8}$ = 50%

5. Discussion and Conclusions

The experiments carried out in order to save seal meat and seal offal onboard vessels on sealing grounds have been shown to be viable both from a practical and an economic point of view. With the quota regulations implemented in this industry, a situation has arisen which means that the traditional products, skin and blubber, are not enough to sufficiently utilize the carrying capacity of the vessel. Utilization of the meat and offal will therefore in most cases be possible and should result in a considerable increase in the value of the catch.

But even if the total carrying capacity of most vessels theoretically indicates that the whole catch can be carried, conditions with respect to tank distribution, etc, mean that practical problems can occur with the distribution of various products onboard. Smaller vessels would under all circumstances have space problems.

It is therefore likely that it would be practically impossible to meet the non-dumping requirements in the East Ice with the present catch quota split between 4 vessels. However, a couple of alternative solutions to this problem can be considered.

One is that a special vessel be chartered to carry seal silage from the sealing grounds. This could be organized so that a suitable vessel arrives on the grounds a few days after the start of the hunt and visits each sealing

vessel for transfer (collection) of silage for transport directly to the user's location.

The economic implementation of such a project will not be evaluated here, but it will probably be necessary to have some form of public support in order to carry it out.

The other alternative would be to distribute the quota among 5 vessels. p. 49

With the present catch quota the increase in value by saving the meat and offal would be at least 2.4 million kroner.

Information from A/S Rieber & Co. indicates that a normal sealing trip gives a gross yield of 1.1 to 1.2 million kroner per vessel.

Under the assumption that there is a possibility of selling the four different products, namely skin , blubber, meat and silage at normal prices, a quota division on 6 vessels will give the same gross economic yield as todays situation.

By dividing the quota between 5 vessels, the economic result would therefore be better than today.

The experiments carried out in this project have shown that production of frozen meat for human consumption and silage for animal feed can be carried out on the sealing grounds. Handling and distribution (freighting) of plate-frozen seal meat can be carried out by traditional methods for frozen products.

Silage can be han'died and distributed most

rationally by pumping and transport in tanks, possibly containers. This presumes that tanks are built to receive and store the silage at user locations.

Pilot production of food products (sausage and canned meat and minced products) carried out at three different plants has shown that seal meat can be used as an ingredient in specialty products.

The feeding experiments that were carried out with mink at NLH have shown that seal silage is fully satisfactory as an ingredient in feeds for fur animals in amounts up to 12% of the total feed.

Prospects for marketing these products at normal prices should therefore be good both from a quality and a nutritional point of view. However, in order to secure steady markets, efforts on the marketing side must be increased. In addition, it will be necessary to have a well organized marketing and distribution apparatus.

If these assumptions are fulfilled, it is reasonable to assume that it would be possible to solve the problem of the dumping ban in the East Ice in a sensible and useful way.

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Appendix

Sanitary guidelines for handling slaughtered seals. p. 52

1. The general rules established here must be modified according to individual circumstances. The handling procedures will chiefly be carried out on board the vessels when seals are caught from the sea, but also on the ice when ice sealing takes place.
2. Bleeding must be carried out as quickly as possible after killing. When hunting from the sea, the animals must be cut (stuck) before being hoisted onboard the vessel.
3. When skinning a seal when the meat is to be used, extreme caution must be used so that the carcass is not contaminated with urine and feces.
4. As much blubber as possible should be removed in the skinning process.
5. Skinning must be carried out carefully so that the abdominal cavity is not opened or cuts made in intestines and other *organs.*
6. Removal of the chest and abdominal cavity organs must be carried out without unnecessary delay.
7. After skinning, the seal carcass must be placed on a clean surface. The carcass is washed with clean seawater if necessary.
8. The head is chopped off.
9. Cuts are made on each side of the breast bone. The

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7. After skinning, the seal carcass must be placed on a clean surface. The carcass is washed with clean seawater if necessary.

8. The head is chopped off.

9. Cuts are made on each side of the breast bone. The

cut is continued along the middle of the belly towards the hip area.

10. The diaphragm is cut down.

11. Grab hold of the windpipe and food pipe and loosen these from throat and chest together with other chest organs.

12. Cut loose the diaphragm.

13. Remove the abdominal cavity organs without cutting a hole in these.

14. The abdominal cavity organs can best be loosened backwards towards the hip region. The back part of the seal can then be chopped off between the tail and the hip in front of the loosened guts. The carcass is hosed down with clean seawater.

15. Seal carcasses that are to be used for human food must be kept separate from other carcasses.

16. Clean seawater for washing and rinsing slaughter-area and equipment must be available.

17. The slaughtering operations must be carried out on a surface that is easy to keep clean and that can be hosed down with clean seawater during operations.

18. The butchers shall practice the best personal hygiene possible.

19. Hands must be washed after visits to the toilet.

20. Equipment and hands shall frequently be washed clean of blood and gut contents etc.

21, When slaughtering-one must try not to cut into

intestines and other internal organs.

22. Contaminated tools such as knives, saws and axes must not come in contact with the meat. Special care must be taken when working in the tail region.

23. The parts o f the working clothes that can be hosed down shall be kept clean at all times.

24. The area must · be kept as neat and orderly as possible.

25. The parts of the seal that are to be used for human consumption must be kept separate from meat and organs for other purposes. Meat for human consumption shall be placed on a clean surface such as grates, plastic, clean tarpaulin and be left there until cooled to room temperature.

26. After the daily slaughter, a thorough cleaning of work area, knives, axes, saws, steels, etc. y shall be carried out.

27. Each man is responsible for keeping his workplace clean during operations.

p. 54

The aim is to utilize only the meatiest parts of the seal, A further cutting of the seal carcass after the chest and stomach organs are removed must be done accordingly.

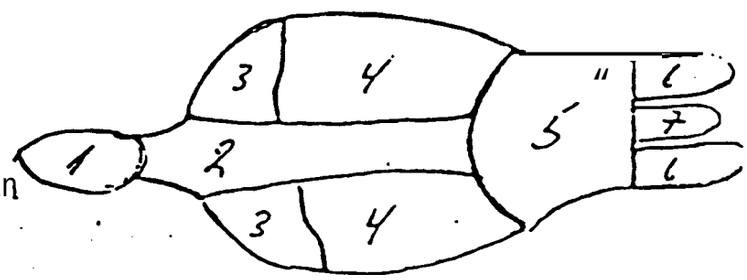
The space for carrying meat on board is very limited, and the meat should therefore be cut carefully. After the seal is slaughtered and washed with seawater, the butcher must cut out the largest meat pieces from the carcass. These are cut so that they are about 10 cm thick. After cooling down, they are placed in plastic bags with 10-15 kg in each

bag. The bags are transferred to the freezer as soon as possible.

Since meat from adult animals is of a different quality than meat from pups, the meat must be labelled to keep each age group separate. Most meat by far will come from adult animals.

TIE carving of the seal. carcass can be carried out according to this sketch:

1. Head
2. Neck and back
3. Shoulder
4* Ribs and flank
5* Kidney end of loin
6. Back flipper
7* Tail bone -



Preservation on board is either by freezing or salting. Cold storage rooms or containers for salting must be cleaned thoroughly before being taken in use.

When returning from the sealing grounds, it is requested that vessels carrying seal meat contact the o f fi cial meat inspection in Aalesund and Tromso in order to have a quality inspection carried out.

Kjell Aurstad

Veterinary Inspector.

Letter from Norwegian Fur Animal Breeders Assoc. : p. 55

To Institute for Poultry and Fur Animals 2.9.1982

Norwegian Agricultural College, Aas.

Analyses o f 3 raw material products, our Nos. 801-803/82

The samples were received on August 18 and were analyzed chemically and bacteriologi cally with the following results:

Our no.	Sample marked	pH	Dry matter %	Ash %	Crude Protein %	Crude Fat	Total bacterial et/g	Coli form per g	Fung pe g
01[1]	Silage from seal carcasses	4.60	35*7	5.0	21.6	6.2	400	<10	<100
02[2]	Fermented slaughter 0 f fal	4.35	29.2	1.6	11• 7	11.9	> 500 mill	"	200
03[3]	Fermented Flow-Therm	4.50	36.7	6.3	9.7	14.3	> "	" "	9500

We refer to our reply of 26/7-82, j. no. 692-694/82

1) The sample is from same lot and barrel as j. no. 692

2) The sample is from a new lot, not identical to j. no. 694.

3) The sample is from the same lot as j. no. 693 but is a newly-fermented batch.

The bacterial flora is also now dominated by lactobacillus-like colonies.

Sign.

Letter from Norwegian Fur Animal Breeders Assoc.
To Gloppen Fur Animal Feed Coop.
Sandane.

24.6.83

p. 5

Analyses of seal meat silage, our j. no. 424 and 425/83

The samples were received on April 29 and were analyzed chemically and bacteriologically with the following results:

Our j. no.	Sample marked:	pH	Dry-matter	Ash %	Crude Protein %	Crude fat %	T.V.N. mg/100g	Total ct/g	Coli-form /g	Fung- pe: g
424	*Seal* meat silage	4.45	32.3	3.9	22.4	4.7	71.7	40,000	'10	.. 100
425	" " (many tendons etc)	4.45	3305	4.1	22.3	3.2	76.7	70,000	"	"

The chemical composition appears to be normal while the TVN (total volatile nitrogen) value and pH could be lower without this being of any special importance for the usability of the silage.

Sign

61.

PELSDYRFORSØKSLABORATORIUM
Fur Industry Laboratory

Oslo, den 24/6 1983.

FTFI To FTFI, Tromso
v/ ing. Bjarne Stormo
Stokkevoldveien 23,
9000 TROMSØ.

Analyses of Silage from seal carcasses, our j. no. 384-393/83
Analyse av ensilerte selskrotter, våre j.nr. 384-393/83.

Prøvene ble mottatt den 21. april og er undersøkt kjemisk og bakteriologisk med følgende resultater:
The samples were received on April 21 and were analyzed chemically and bacteriologically with flwg resu

Våre j.nr. Our j. no.	Prøve merket Sample marked		pH	Tørr-stoff (1) %	Aske Ash	Rå-prot.	Rå-fett (2)	T.V.N. mg/100	Peroxyd all (4)	Totalk. pr.g. (5)	Koliforme pr.g. (6)	Sopp pr.g (7)
	Minced seal carcasses, 1st production day											
384	Malte selskrotter, 1.prod.dag.	I.	3,85	34,4	4,7	24,3	4,5	19,1	7,8	6200	<10	<100
385	" "	II.	4,45	33,9	3,8	21,9	5,3		7,4	1700	"	"
386	" 2. "	I.	4,30	34,1	4,2	22,9	5,1		8,9	500	"	"
387	" " "	II.	3,95	35,9	5,1	24,8	3,9		9,1	12 ingen vekst påvist		
388	" 3. "	I.	4,25	34,7	3,9	25,1	4,1	24,1	13,6	30000	<10	<100
389	" " "	II.	3,80	36,8	4,8	25,9	3,5	12,1	10,1	200	"	"
390 (8)	Ensil:selskrot. (fra toppen av tanken		4,50	33,3	4,2	22,8	4,0	77,3	5,7	520000	"	"
391 (9)	" (ca.1/3 ned i tanken)		4,45	34,9	3,8	23,9	5,1	67,3	5,1	560000	"	"
392 (10)	" (ca.2/3 ")		4,60	36,7	4,7	24,3	6,2	76,7		560000	"	"
393 (11)	" (fra bunnen		4,45	36,9	6,4	22,8	5,1	68,1		520000	"	"

Til sammenlikning nedenfor våre analysedata (j.nr.530-534/82 for prøver ifjor. (13)

Vårt j.nr.	Prøve merket	pH	Tørr-stoff	Aske	Rå-prot.	Rå-fett %	Flyktig N (Volatile) mg/pr. g	F.F.A. %	Totalkim pr.g.	Koliforme pr.g.	Fungi Sopp pr.g.
530 (14)	"Nyprod.vare"	4,30	33,3	5,0	22,5	6,0	25,6	---			
531	"	4,30	38,3	4,6	22,4	6,3	26,8	33,0	No growth demonstr.		
532 (15)	15 dager gammel vare"	4,35	36,7	5,4	22,9	6,2	23,8				
533 (16)	20 dager gammel vare"	4.5°	3[illegible].5	4.[illegible]	[illegible]3.9	[illegible].8	[illegible].8		2°°°°	<1°	<1°°
534 (17)	"30 dager gammel vare"	4,45	37,4	4,8	23,5	7,0	26,8		(12) ingen vekst påvist no growth demonstr.		

Translation from page 61.

1. Dry matter %
2. Crude protein %
3* Crude fat %
4. Peroxide value
5. total germ count per g.
6. Coliform per gram
7. Fungi per gram
8. Seal carcass silage (from top of tank)
9* " " " (ea. 1/3 down in tank)
10. " " " (ea. 2/3 ")
11. " " " (from bottom)
12. No growth demonst.
13. For comparison, below our analytical data (j. no 530 534/82) for samples last year:
14. Newly produced product
15. 15 days old product
16. 20 days old product
17. 30 days old product

Norwegian Fur Animal Breeders Assoc. p. 58

To Dal Experimental Farm

1380 Heggedal

22.8.83

Analyses of three samples of seal carcass silage, our j. no. 822-824/83.

The samples were taken on August 9 from a freezer trailer on its way to Dal Experimental. Farm (from three different blocks). The results of our chemical and bacteriological analyses were as follows:

Jr no:	pH	Dry Matter %	Ash %	Crude Protein %	Crude Fat %	FFA %	Peroxide no.	T.V.N. mg/100g	Total ct/g	coli-form /g	Fungi per g
822									25,000	<10	<100
823	4.6	32.5	4.6	21.9	4.4	20.2	6.1	87.7	6,500	"	"
824									20,000	"	"

The analytical values are therefore in the same range as earlier samples of the year's seal silage production.

For the chemical analyses all three samples were blended together and the results listed under j. no. **823.**

Sign

REPORT

Studies on survival of trichinae in acid silage

by

Mona Aleksandersen

Institute for Food Hygiene
Norwegian Veterinary College

Intro duction

Starting with the sealing season in 1980, a ban against the dumping of seal carcasses has been in force in the East Ice. This has created problems for the sealing industry, and there is therefore considerable interest in methods to utilize the seal carcasses. A possible alternative is to use the carcasses as feed for fur animals, after making them into silage onboard the sealing vessels.

There is a theoretical possibility that trichinae can be transferred to fur animals through seal meat. The Institute for Food Hygiene has therefore, at the request of the Veterinary Branch in the Ministry of Agriculture, carried out laboratory experiments with silage production of trichinae-containing material in order to determine if the trichinae can survive under acid silage conditions. The trials were carried out with methods resembling as much as possible those . intended to be used during seal hunt.

On the vessels the carcasses are chopped up (coarsely ground) as soon as possible after skinning. An acid mixture of formic and propionic acid is added before the mass is finely ground. The silage will be stored onboard the vessels from 2-3 days and up to 30 days or so.

Description of Experiment

The experiment was carried out in two parts. In Trial 1, mouse meat infected with trichinae was made into

silage while in Trial 2 infected mouse meat was mixed with non-infected seal meat and made into silage. Trichinae-infected mice used in the trials were infected ca. 1 year earlier.

Trial 1.

Three mice with trichinosis were killed and "slaughtered". The mousemeat was analyzed for trichinae by trichinoscopy. The meat contained numerous trichinae. After homogenizing, 2.5% of an acid mixture consisting of 5/6 formic acid and 1/6 propionic acid was added. The acid was well mixed with the meat and the mixture left at room temperature for seven days.

After one week the mass was examined for presence of trichinae. A digestion method with pepsin and hydrochloric acid was used. After seven days the mass was also fed to mice. Five laboratory mice (♀♀, weight ca. 20 grins) were starved for one day and were then fed the silage as only feed for 2 days. The mice ate the silage well. After two days they were put on ordinary feed. About twelve weeks later the mice were killed and analyzed for trichinae both by trichinoscopy and a digestion method.

Trial 2.

The second part of the trial" was carried out in a similar way. Five trichinosed mice were killed. Fifty grams trichinosed mouse neat was *now* mixed with 50 g non-infected p. 61

seal meat. Silage was produced as under Trial 1. After seven days storage the silage mass was fed to five laboratory mice. About twelve weeks later the mice were killed and examined for the presence of trichinae as in Trial 1.

RESULTS

After storage for seven days the silage mass was examined for trichinae in both trials. Whole trichinae could not be found.

In the group of mice that were fed with silage from the two trials, no trichinae could be found in the mouse muscles twelve weeks after the start of the feeding experiment.

Conclusion

The silage experiments with subsequent feeding trials of the silage to mice have shown that in silage made with a 2.5% acid mixture (5 parts formic acid; 1 part propionic acid) and stored for seven days at room temperature, the structure of the trichinea was destroyed and therefore also their infective properties.

From: Food Inspection Laboratory, Harstad

To: The Royal Ministry of Agriculture
Veterinary Branch
0s10

23.6.82

Report from Harstad Meat Inspection Service. p. 62

Trichinosis inspection of samples from 500 seals received in week 22 from engineer B. Stormo, Institute for Fisheries Technological Research, Tromso.

The technique used was the magnet-tube (pipe) method as practiced by Knut Framstad during a visit here on May 25. A total of 10 grams of seal meat from each seal was examined. After the first precipitation for 30 minutes the samples were dark and opaque to various degrees. There were many relatively large dark particles that could interfere and hide trichinae that may be present when observing the solution in the counting chamber. After conference with Knut Framstad, the last 15 ml. of the residue (the part that should really be investigated) was diluted with physiological saline and transferred to a separator funnel for precipitation (settling) of trichinae for further 30 minutes. Most of the dark sediment remained suspended on top (floating) under these conditions so that the sample material in the counting chamber could be searched for trichinae with a high degree of confidence.

In order to check on the method, trichinosed material from mice was added on three occasions without alerting the operator in advance.

When adding samples with at least 9 trichinae present, eight were found, and when a sample with 17 trichinae was added, 21 were found. When a sample with 2 trichinae was added, 1 was found.

Conclusion: Samples from 500 seal carcasses were investigated for trichinae by the magnetic tube method without trichinae being found.

From: Trondheim Preserving Co. (Canning Co.) p. 63

Products of Seal Meat

As the first factory in the world, our firm has this year produced products from seal meat for regular commercial markets.

The two products that are now available on the market are:

POLAR CAKES and POLAR STEAK packed in wild game gravy ("viltsaus") and made of the best kind of seal meat. The meat comes from the hunt for Hooded Seals (Should be harp seal according to the rest of this article. Transl. note) at Newfoundland and Greenland. It has been deep-frozen practically from the instance of kill until it was processed. It has also been inspected by the Veterinary Control Service with some of the results being:

	Fat %	Protein %
Raw seal meat	1.0	28.0
Canned Polar Meat	1.2	33*9
Canned Polar Cakes	3*5	13.9

The veterinary comments included the following:

"The canned products were sampled organoleptically and judged as follows: The products had a typical wild game flavor; fish-oil flavor was not detected. The seal meat in "game gravy" had a relatively loose and coarse texture. It was judged to have a good flavor. The seal meat cakes had a somewhat loose texture. The gamey flavor was also here quite pronounced. The cakes were characterized as being tasty. Three cans of seal meat and three cans of seal cakes were incubated at **37°C** for 10 days, opened under sterile conditions and analyzed bacteriologically. No micro-organisms were demonstrated in any of the cans."
End quote.

Sign

From: City of Trondheim
Health and Social Care Branch
Meat and Food Inspection
Trondheim

To: Trondheim Canning Co. Ltd
Trondheim

Seal Meat and Seal Cakes

Samples of raw, frozen seal meat were taken 10/11-1977 from the Frionor cold storage in Trondheim. Six cans of canned seal meat in game gravy were received 7/10-1977 from Trondheim Canning Co. Ltd.

Three cans of seal meat and three cans of seal cakes were incubated for 10 days at 37°C, opened uncle-r sterile conditions and examined bacteriologically. In none of the cans were micro-organisms demonstrated.

Chemical analyses of the products gave the following results:

	Fat %	Starch %	Protein %	Ash %
Raw seal meat	1.0		28.0	1.2
Canned seal meat	1.2		33.9	1.0
Seal-meat cakes	3*5	6.1	13.9	1.9

The canned products were sampled organoleptically and judged as follows:

The seal meat in game gravy had a relatively loose and coarse texture. The product had a pronounced, almost

sharp gamey flavor, fish-oil flavor was not noted. The seal meat was judged to have a. very good taste.) The seal meat cakes had a relatively loose texture. The gamey flavor was also here quite pronounced. The cakes were characterized as tasty.

The raw seal meat was dark in color, on thawing there was a large amount of dark bloody water given off. The pH 0 f the meat was 5.5. We have no experience in evaluating seal meat, but color and run-off (drip) can indicate that the meat sample had been poorly bled. The pH of the meat seems to be satisfactory and is similar to values found in neat and fresh animals that have been properly bled.

Sign

From NKL (Coop) Central Laboratory p. 6

Analysis Report for Foods

Product: Polar cakes No. and rec'd: J. No. 165/'78. 27/4-1978

Producer: Trondheim Canning Sent in by: Retail Store, Soberg

Results:

Gross wt:	955 g	Water in cakes	73.2%
Net wt:	805 g	Salt: in gravy	1.4%
Net wt of cakes	465 g	" in cakes	1.4%
		Fat: in cakes	3.2%
		pH in gravy	5.6

No. of cakes : 12

Protein in cakes: 15.2%

Special investigations and notes:

Taste test: Nice appearance, even-sized cakes. A little too dense and finely ground texture to our taste. Good flavor, delicious thin gravy.

Recommended!

Oslo, 22. 5. 1978

Sign.

NKL (Coop) Central Laboratory p. 6

Analytical Report for Foods 47,4.197$

Product: Polar Steak No. and rec'd: J. no. 166/78 27/4 -1978

Producer: Trondheim Canning Sent by: Retail Store, Soberg

Analytical Results

Gross weight:	1015 g	Water in meat	61.4%
Net weight:	865 g	Salt: in gravy	008%
Net wt. meat:	375 g	in meat	0.3%
		Fat: in meat	1.1 %
		pH in gravy:	6.2

Special investigations and notes

Taste test: Tender meat, good distinctive game flavor, robust. Delicious gravy, fine thickness, Recommended!

Sign

From: T. Bjornebraten Ltd. Sausage Factory-Food Center p. 67

To: Institute for Fisheries Technology Research
Tromso Nov 3, 1983

Seal Meat in Cured Sausage Production

I refer to telephone conversation in October of this year. In our conversation I was commenting on the treatment of the meat which will be of deciding importance for future use and sale of these products.

The meat is basically of excellent quality, it is lean and has a high ability to "absorb" quantities of fat

meat. That this is unimportant factor these days when products should contain so little fat is self-evident.

But the meat must be treated much more carefully on the "slaughtering ground" than it has been previously.

It should be frozen in plate freezers, and the freezing capacity should not be exceeded. The freezing equipment must be in order before the vessel leaves for the hunting grounds. Since seal meat has a very dark color and also a somewhat special. taste, this meat type has limited areas of utilization. However, there are some suitable products that can become commerciably viable. Seal meat must then be made known among people (the customers). Information must be issued regarding quality, nutritional content, handling-freezing etc. and also that seal meat is a resource "that must be utilized. I hope that you will succeed in your work here since for me (our firm) the trials with seal. meat have been rather expensive. This is due to poor quality and for reasons mentioned earlier in the letter. However, one reason was several sales at reduced prices in 1982. At this time, the end of 1983, meat prices are considerably higher, so I believe that the future could be good for seal meat.

Sign

From: Nora Food Products Ltd.

Seal Meat as Raw Material for Cured Sausages

NORA purchased some time ago some seal meat of two types, namely pure (steak) meat and flippers for use in a type of cured sausage.

NORA produces their cured sausages at Stranda, Sunnmore County and is one of the largest cured sausage producers in Norway. The bulk of the cured sausage production consists of standard products defined by food product regulations and meat regulations, and only defined raw materials are permitted. The most common types are salami, mutton sausage and "stabbur" (Summer) sausage.

In addition there has been a market demand for certain less expensive types of cured sausage. These types must meet basic specifications for cured sausage set out in the meat regulations but can use other types of raw material (for example whale meat, seal meat, soy protein), if this is declared on the package.

We chose, after some experimentation to utilize seal meat in our low-price version of "Stabbur" sausage known as Hedmark Poise (sausage).

For your information, Stabbur sausage is a dark product made dark originally by the use of horse meat and of blood or blood powder. In our Hedmark Sausage we chose to replace most of the high-priced (kr. 38 per kg) lean horse meat with seal meat. Production and marketing of this product has been underway for almost a full year.

Experi ences

Seal meat is technically easy to use in the production process. The objections we could have had are that there were too often bloody sections which are not directly visible in the dark sausage.

As a freshly produced product the taste is acceptable. Our experience is that rancidity occurs more rapidly in the type of fat found in seal. meat than in the usual types of fat from cattle and pork. More importantly, it has a different and sharper flavor (characterized as soapy flavor) than corresponding flavors of rancid fat from cattle and pork. Cured sausage should have a shelf life of about half a year. However, our experience with products containing seal meat was that these products attained such a distinct rancid flavor from the seal meat that we had to terminate the production of this product when our stocks were used up.

We have at the present time no further plans for utilizing seal meat in our cured sausage production due to this problem.

Conclusion:

Our conclusion is that seal meat, due to the flavor that develops from rancidity, is not suitable for use in products with long storage times such as cured sausage. We have no experience with seal meat in products with short storage times or in sterilized products, but we believe that the meat is better suited for these products.

Brumunddal, 14/10 -1983.