CONFIDENTIAL

FISHERIES RESEARCH BOARD OF CANADA

ANNUAL REPORT OF THE GASPE FISHERIES EXPERIMENTAL STATION FOR 1951

BY A. NADEAU

With investigators' summaries as appendices

GRANDE RIVIERE, P.Q. December 1951.

C O N F I D E N T I A L

FISHERIES RESEARCH BOARD OF CANADA

ANNUAL REPORT

OF

THE GASPE FISHERIES EXPERIMENTAL STATION

FOR

1 9 5 1

BY A. NADEAU

With investigators' summaries as appendices

GRANDE RIVIERE, P.Q. December 1951.

FISHERIES RESEARCH BOARD OF CANADA

REPORT OF THE

GASPE FISHERIES EXPERIMENTAL STATION

GRANDE RIVIERE

FOR 1951

BY A. Nadeau

The Gaspé Station has continued for another year, its role in the development of the fishing areas of the Province of Québec. At the beginning, progress was rather slow on account of the very small staff and lack of trained personnel. But after fifteen years operation - the Station having been established in 1936 - the situation is greatly improved. The scientific personnel has been increased over threefold. The senior staff who has now many years of experience in different branches of fish technology is able, with the help of a good team of young scientists now at work, to carry on effectively the programme of research. In fact the progress of work was particularly remarkable in these last years so that some investigations are now considered sufficiently advanced to warrant application on a commercial scale. As we can see in the appendices of this report a large part of our efforts in 1951 was devoted to the application of results obtained in the laboratory.

No major alteration has been made to the Board's property during the year, although the lack of working space would require an enlargement of the Station as already mentioned in the previous years report. But on account of the present restriction on capital expenditure there is little possibility that this acute problem be solved in the near future. In the meantime, a temporary solution has been found, through the kindness of the direction of l'Ecole d'Apprentissage en Pêcheries who spared a room as they did last year. This room was available only during the summer months. This fall, arrangements have been made with the Provincial Department of Fisheries for a year round accommodation in a basement of a building (25' x 35') close to the Station, occupied by La Station Biologique du St-Laurent, now under the care of that Department. We greatly appreciate the collaboration of the Provincial authorities in that field. We hope that this arrangement will facilitate the work of the engineers who have a really poor accommodation at the Station. There is no guarantee how long that occupancy would be. This will depend on the requirement of the Station Biologique for their staff. But for the time being, we are very pleased to have this basement at our disposal.

Some erosion occurred along the most exposed part of the concrete sea wall. Repairs were made by placing, along the base of the wall, heavy boulders which were cemented together. This work is particularly difficult on account of the tide. We are obliged to interrupt the work at practically every high water. More than half of the job could have been finished this autumn but the weather conditions did not permit to complete it. The work will be resumed next spring.

As mentioned in last year's report, the electric power is now furnished at the Station by the Gaspé South Electricity Cooperative. Its service was satisfactory. No interruption of current occurred from May to November except for a few hours for repair work. We are generally advised in advance for such interruption. But during the winter, severe storms are sometimes the cause of more frequent interruptions and the diesels were found useful as standby. But each year the distribution line is improved and with time, it is presumed that, even in the winter, the interruption of current will be less and less frequent. In the meantime, it is wise to keep our diesels as standby to guarantee a continuous supply.

Among the acquisition of equipment are: four spychrometers, a blower of a capacity of 7000 c.f.m., a steam heater and an electric hygrometer controller with a multi point adapter. All this equipment was required for the investigation on light salted fish. The Station has also purchased a new truck, a Ford Panel Delivery Model 51, to replace the old one which was in use for over ten years.

The construction of two insulated rooms mentioned in the last year's report to be used for the experiment on light salted fish were completed early this year, so that it was possible to start the investigation on light salted fish as soon as fish was available on the Coast.

The staff in 1951 was 21. Among the members 6 are permanent in the terms of the Superannuation Act of the Civil Service; 6 are full time employees; 6 are still on probation; 2 are seasonal workers and one vacancy. The number of scientific personnel was the same as last year but there was one resignation, Mr. L. Riou, assistant chemist. On the other hand, one addition was made with the appointment of Mr. H. Dupuis, M.Sc., a graduate from the Ecole Polytechnique, as assistant scientist (engineer) to work on the problem on light salted fish. Unfortunately after three months service, he gave his resignation.

An extension of an educational leave for another year was granted to Mr. A. Cardin to enable him to complete his thesis under supervision of Dr. T. P. Hilditch of University of Liverpool.

Two seasonal workers instead of four joined the staff to give assistance to the scientific personnel. Mr. R. Lanthier came up with the oil workers and Mr. A. Domnas, for the second summer, was engaged in salt fish investigation. The addition of such workers did appreciable service to the Station. The only inconvenient is that their stay is generally too short.

There were some changes among the non-scientific staff. Miss Y. Lavoie, clerk Grade 2A, and Mr. R. Cauchon, Assistant Technician, resigned respectively in February and June. Mr. J. B. Bérubé who made a stay at the Station as summer worker last year, was appointed Technician Grade 1, effective April 1st, to give assistance to the engineer. Miss H. Berthelot, clerk Grade 2A, was appointed April 1st to replace Miss Lavoie. There is still a vacancy to a position of technician. Applications have been received and it is hoped that the best qualified candidate be appointed in the near future. No change occurred during the year for the maintenance staff.

The modification of the staff has led to some reorganization of the research staff who might be separated into 4 divisions instead of 5 as last year. The chemistry division has been absorbed by the biochemistry division except for a few investigations which could be carried out most efficiently by the engineering division; the others remain unchanged (see Annual Report 1950, page 4).

A look at the list of the personnel at the following page shows that the distribution of personnel is in general well balanced except for the biochemistry division where, at our point of view, an addition of a qualified scientist would be desirable to give adequate assistance to the senior man. The restrictions regarding the personnel do not leave many chances to improve the situation at the present time.

The Station continued to give technical assistance to the industry, particularly in the installation of modern smoke houses. Two new units were in operation this year and probably others will be installed next season, as some inquiries have already been received in this regard.

ORGANIZATION OF STAFF AS OF SEPT. 1951

(21 members including seasonal workers)

ADMINISTRATIONAL STAFF

Director	A. Nadeau, D.Sc.
Administrative Assistant	R. Dubé
Stenographer and clerk G.2A	H. Berthelot (Miss)

INVESTIGATIONAL STAFF

1. Biochemistry	
Senior Biochemist	H. Fougère, Ph.D.
Technician G.1	Vacant
Sen. Res. Assist. (seasonal)	A. Domnas, B.Sc.
2. Marine Oil Chemistry	
Senior Biochemist	L.C. Dugal, D.Sc.
Assist. Chemist	A. Cardin, M.Sc.
Assist. Organic Chemist	C.A.Olivier, D.Sc.
Jun. Res. Assist. (seasonal)	R. Lanthier, B.A.
3. Bacteriology	
Assist. Bacteriologist	H.P. Dussault, M.Sc.
Assist. Bacteriologist	R.A. Lachance, M.Sc.
Jun. Lab. Assist. G.2	J. Thibodeau (Miss)
4. Engineering	
Assist. Engineer	R. Legendre, M.Sc.
Assist. Engineer	H. Dupuis, M.Sc.
Technician G.1	J.B. Bérubé, T.D.

MAINTENANCE STAFF

Maintenance Supervisor G.4	C. Chartré
Maintenance Supervisor G.2	E. Roussie
Caretaker G.3	Y. Lambert
Caretaker G.2	G. Duguay
Caretaker G.2 and night watchman	N. Diotte

Important fishing developments are being initiated in the Province of Québec, particularly on the Gaspé Coast. For some years the production is decreasing and the income to fishermen is very low on account of the cost of living. A serious inconvenient to the normal development of the fishing industry is the scattering of fish processing plants all along the Coast without any center of importance. For all these reasons, the fishing industry proceeds toward a failure if no remedy is applied to this situation. One solution to the problem is the modernization of the fishing methods. By the initiative of the Provincial Department of Fisheries, preliminary experiments with small draggers and long liners have been carried out during this season, and some of these boats will be in commercial operation next season. Larger boats mean larger quantities of fish. The introduction of these boats will lead necessarily to the improvement of fish processing plants on land. Larger plants, well equipped, will be required in centers which can offer facilities for such expansion. By force of circumstances, the fishing will be concentrated in a few centers which can offer good protection for boats as well as facilities for production and transportation of the finished product. It is the only way to establish the industry on a profitable basis. This expansion cannot be carried out without involving many problems. The Station is prepared to pay great attention to those problems particularly in regard of modernization and layout of fish plants of such capacity to process the daily catch in a reasonable time. The mechanization is now greatly facilitated as electric power is available in all the fishing centers of importance.

The Consultative Committee which held two meetings during the year, contributed greatly to maintain a close liaison with the Station and the industry. These meetings offered an excellent occasion to review the investigations in progress at the Station and chiefly to discuss new problems when they arise and make a choice of the most urgent ones. The purpose of such a committee is to act as a guide in elaborating a programme of research.

It is a pleasure to mention that a closer collaboration was maintained with the "Station Biologique du St-Laurent" which is now under the supervision of the Quebec Department of Fisheries. They did a real service to the Station in supplying fish for some investigations, particularly during the fall season when fish is scarce on the Coast. L'Ecole d'Apprentissage en Pêcheries, another Provincial organization has also collaborated in offering graciously the facilities of its mechanical equipment for some special work which could not be performed at the Station. In return, the senior staff has rendered service to the School by giving lectures on fish technology to different groups of people.

The Station continued to collaborate with fisheries inspector for the maintenance of the quality of the production. The trimethylamine content was determined on samples of frozen fillets collected by the inspectors. The delay which might have occurred in some occasions in issuing the result, was due to more urgent work and lack of personnel. As far as the Station is concerned, it is hoped that this service will operate on a more efficient basis next year.

The writer attended the meeting of the Quebec Fish Producers and Exporters Association in Quebec City in March and of the Quebec United Fishermen in May at Grande Rivière. Dr. Fougère made a visit to Newfoundland in relation to the investigation of light salted fish. With Mr. Dussault, he attended the meeting of L'ACFAS held in Montreal in October where he read a paper on "The effect of salt on the amino acids of cod muscle juice" and Mr. Dussault presented one on "The amino-acids of Red Bacteria". In November, in Ottawa, Dr. Dugal read a paper on "Hydrogenated Seal Oil" at the annual meeting of the Subcommittee of Fats and Oils of the Canadian Committee on Food Preservation.

<u>RESUME DES TRAVAUX DE RECHERCHE EN COURS</u>

La Station Expérimentale de Pêche de la Gaspésie s'est intéressée, avant tout, aux problèmes particuliers de la Province de Québec. L'élaboration du programme de recherche s'est faite en tenant compte des besoins particuliers de l'industrie, qui par suite d'un certain esprit de routine est assez lente à s'adapter aux méthodes modernes de production. Bien qu'il reste beaucoup à faire, un progrès sensible s'est fait sentir dans certaines régions maritimes de la Province, en Gaspésie en particulier, où on a pu mettre en pratique de nouvelles méthodes expérimentées à la Station.

Le travail de recherche pour l'année en cours a surtout porté sur l'étude du salage et du séchage du poisson légèrement salé, type "Gaspé cure", une spécialité de la Gaspésie, et aussi sur l'hydrogénation de l'huile de phoque, une ressource naturelle qui intéresse à la fois les provinces de Québec et de Terreneuve. Afin de maintenir une plus grande continuité possible dans le programme, il a fallu laisser de côté certains problèmes qui ne manquaient pas d'intérêt mais dont la solution paraissait moins urgente.

Le poisson salé

Depuis quelques années le poisson légèrement salé type "Gaspé cure" a fait l'objet d'une étude toute particulière. Ce poisson fait prime sur certains marchés entre' autre sur celui d'Italie, qui est un débouché intéressant pour le poisson de première qualité. Le poisson de qualité inférieure est vendu sur d'autres marchés, à prix inférieur il va sans dire, et assez souvent en bas du coût de production. Il arrive assez souvent qu'une forte proportion de la production est de qualité inférieure par suite soit d'un salage mal fait soit des conditions atmosphériques défavorables pendant le séchage. On a voulu rendre la production le moins aléatoire possible en faisant une étude scientifique des transformations que le poisson subit dans les différents stages de sa production, pendant le salage et le séchage. C'est dans ce but que des recherches théoriques et d'applications pratiques ont été commencées sur ce sujet il y a déjà quelques années. En 1951, on a voulu vérifier sur une base semi commerciale quelques-uns des résultats intéressants obtenus au cours d'expériences de laboratoire sur le salage. On avait constaté que pour une certaine concentration de sel, de 8 à 10 lb. par 100 lb. de poisson, il y a formation d'un gel, qui en séchant donne au poisson une surface quelque peu translucide, caractéristique du "Gaspé cure". Avec l'aide d'un homme de métier dans la fabrication du poisson légèrement salé, on a fait une série d'expériences sur le salage en suivant aussi près que possible la façon ordinaire de procéder mais en tenant compte de la température de salage et de la quantité de sel par 100 lb. de poisson.

Les résultats ont confirmé dans une large mesure, ceux déjà obtenus au laboratoire. La quantité maximum de sel à employer par 100 lb. de poisson est de 10 lb., mais en pratique, 8 lb. est préférable si on veut obtenir un poisson salé avec les caractéristiques du "Gaspé cure". A 10 lb. il y a danger d'avoir un excès de sel sur le poisson une fois séché, si le salage a manqué moindrement d'uniformité. La température de salage ne semble pas avoir une grande influence sur la qualité du produit fini, du moins dans les limites étudiées (40°F. à 65°F.). A 40°F. la pénétration du sel est lente et le poisson doit rester plus longtemps en saumure tandis qu'à 50°F. et 60°F., 2 à 3 jours suffisent. La température de 50°F., du moins dans l'état des expériences, s'est avórée la plus pratique. Une fois le salage terminé, si les conditions atmosphériques ne permettent pas de commencer le séchage, le poisson peut rester empillé quelque temps à cette température, sans s'altérer.

C'est un fait reconnu que la meilleure qualité de poisson séché provient du côté nord de la Gaspésie. Sur le côté sud, le long de la Baie de chaleur, en particulier dans la région où est située la Station Expérimentale, le pourcentage de poisson séché de première qualité est faible. Au contraire, le poisson salé à la Station suivant la méthode décrite plus haut, séché au soleil et classifié, a donné un pourcentage de première qualité des plus satisfaisant. Ce qui vient à dire que, même si les conditions atmosphériques sont moins favorables sur le versant sud de la Gaspésie, il est possible d'améliorer de beaucoup la qualité, pourvu que l'on prenne les précautions voulues. Il est vrai qu'à la Station, on a opéré sur de petites quantités et que dans ces conditions, il est plus facile de surveiller la production. Mais il est certain que du poisson bien frais, salé par un homme d'expérience aussi uniformément que possible dans la proportion de 8 lb. de sel par 100 lb. de poisson, maintenu à la température de 50°F. pendant les deux à trois jours de salage et séché avec toutes les précautions voulues, donnera un produit fini d'excellente qualité pourvu que les conditions atmosphériques soient le moindrement favorables. Mais le malheur c'est que les hommes d'expérience se font de plus en plus rares. C'est un art qui semble vouloir se perdre.

C'est une des raisons qui a amené l'étude théorique des différents phénomènes qui se passent pendant le salage afin de trouver une explication aux méthodes empiriques en usage. Jusqu'ici certains points ont pu être éclaircis. Mais il reste beaucoup à faire pour compléter ce travail qui est particulièrement difficile. Les travaux analogues sont très rares. Bien souvent il faut modifier les méthodes usuelles de recherche pour les adapter aux poisson salé. Ce qui nécessite parfois un travail préliminaire assez long. C'est ce qui est arrivé en essayant la méthode de chromatographie sur papier.

On a cru bon de déterminer par cette méthode, quel est le rôle du sel sur les acides aminés du poisson pendant le salage. Des travaux antérieurs avaient indiqué une certaine variation due au sel. Afin de mettre la méthode au point, on a cherché en premier lieu les acides aminés libres et combinés dans l'extrait musculaire obtenu par pressage de la chair du poisson. On a pu identifier ainsi sans trop de difficulté 12 acides aminés libres et 6 autres combinés qui ont été caractérisés après hydrolyse. Mais en présence des différentes concentrations de sel, il a fallu modifier la méthode avant d'obtenir des résultats satisfaisants. Après plusieurs essais infructueux, il fut possible d'éliminer le sel suffisamment pour empêcher toute interférence à la chromatographie. Les résultats ne sont pas complets à date, mais on a pu constater que dans le milieu témoin, (c'est-à-dire sans sel) sept acides aminés sont disparus avec le temps; tandis qu'en présence du sel, les mêmes acides semblent diminués sans disparaître complètement, par contre, de nouveaux acides apparaissent dans le milieu après quelques jours.

En même temps, on a déterminé par la méthode chimique ordinaire, les variations d'acides amines totaux dans l'extrait musculaire maintenu à différentes concentrations de sel. Pour les concentrations inférieures à 10%, il y a une diminution pendant les premiers jours suivi par après d'une augmentation importante d'acides aminés tandis que pour les concentrations plus élevées la diminution est beaucoup moins prononcée. Après un certain temps, la quantité d'acides aminés est revenue à peu près à ce qu'elle était au début. Ce qui confirme dans une certaine mesure les résultats obtenus par chromatographie.

Poussant un peu plus loin cette étude sur la diminution des acides aminés, on a voulu chercher la présence de produits résultant de la déamination de ces acides. On sait que règle générale, la déamination conduit à la formation d'acides cétoniques. On a donc cru bon de déterminer ces acides cétoniques afin de vérifier les résultats obtenus plus haut. En effet, on a pu constater que le maximum des acides cétoniques est atteint quand la diminution des acides aminés est plus importante. La concordance entre les résultats est assez grande pour conclure qu'il y a réellement déamination suivi de réamination pour les concentrations de sel de moins de 10%. Pour les concentrations plus élevées, le phénomène est moins prononcé.

Les bactéries du poisson légèrement salé

Le poisson légèrement salé type "Gaspé Cure" est caractérisé par une saveur particulière tel que mentionné plus haut. Les bactéries selon toute vraisemblance ont un rôle à jouer dans cette maturation. On a continué, cette année, l'étude de la faune bactérienne sur le poisson salé en bac. L'an passé, l'étude avait porté sur le poisson salé au sel sec (en "arime"). Les résultats obtenus à date sont plutôt préliminaires, mais il ne semble pas y avoir une grande différence entre les deux méthodes de salage au point de vue du développement bactérien. Dans les deux cas, il y a augmentation du nombre de bactéries pendant le salage. Ces bactéries ont été isolées et classées en différents groupes. A date il n'y a que le groupe des coli bacilles dont on a commencé l'étude. Leur nombre qui représente une faible proportion du nombre total au début du salage, diminue continuellement pendant la maturation du poisson pour disparaître complètement pendant les premiers stages du séchage.

Il est au programme d'étudier tous les groupes de bactéries et surtout de déterminer leur rôle dans la maturation du poisson légèrement salé. Pour cela, il fallait en premier lieu, un milieu de culture approprié. Le milieu tout trouvé était le muscle même de la morue ou son extrait musculaire. Mais fallait-il le rendre stérile sans lui faire subir de modification biochimiques? La stérilisation par la chaleur ne pouvait être employée dans ce cas. Après l'essai de différentes méthodes, l'emploi d'oxyde d'éthylène s'est montré le plus efficace. L'addition de 1% d'oxyde d'éthylène sur l'extrait musculaire le rend complètement stérile sans changer la composition des acides aminés du milieu. Mais ce traitement a l'inconvénient de provoquer la coagulation de l'extrait. Sur le muscle même, on obtient le même résultat avec une concentration de 3% d'oxyde à condition que le muscle soit bien déchiqueté afin de permettre le contact intime du désinfectant avec toutes les particules de chair. Cette méthode de base maintenant à point, devrait faciliter de beaucoup le travail à venir.

Un problème bactériologique qui reste toujours à résoudre est celui de la présence du "rouge" sur le poisson fortement salé. Le poisson ainsi contaminé est une source d'ennui pour le producteur quand cela ne lui occasionne pas une perte plus ou moins complète de son produit. La Station s'est intéressée activement à ce problème depuis quelques années. Mais à la suite de difficultés de toutes sortes, les travaux n'ont progressé que lentement jusqu'à date. Cependant, cette année, on a pu mettre à point d'une façon définitive, un milieu de culture supérieur à ceux existant déjà. La préparation est simplifiée et surtout le développement bactérien est rapide et abondant avec une pigmentation prononcée.

De même on a pu améliorer le milieu liquide qui avait été essayé avec un succès assez relatif l'an passé. Se basant sur le fait que les bactéries du "rouge" sont strictement aérobies, on a cru bon de faire barbotter de l'air purifié à travers le milieu. En effet un très bon développement avec pigmentation rouge intense a été obtenu de cette façon. Ce milieu liquide sera sans doute d'une grande utilité pour l'étude du métabolisme de ces bactéries.

Les bactéries du "rouge" ont cette particularité de ne se développer qu'en présence de forte concentration de sel, contrairement aux autres bactéries. Pour essayer de trouver une explication à ce phénomène, on a déterminé en premier lieu les principaux constituants chimiques. Des analyses faites sur la cellule bactérienne même, séchée et pulvérisée ont donné les résultats suivants: 33.4% de protéines; 14.6% de polysaccharides; 3.2% de lipides solubles dans l'éther et 32% de cendre dont 20% de sel. On voit donc que ces bactéries contiennent dans leurs cellules une bonne quantité de sel qui nécessairement doit être fourni par le milieu même si l'on veut qu'elles se développent.

Certains constituants organiques ont aussi pu être déterminés par la méthode de chromatographie sur papier. Cette méthode se prête admirablement bien à cette étude parce qu'elle permet d'opérer sur de très petites quantités de matériel. La présence d'acides aminés libres n'a pu être décelée. Mais après hydrolyse, 13 acides aminés ont pu être identifiés à date, dont l'acide aspertique, l'acide glutamique, la leucine, la thyrosine, etc. Il reste sans doute d'autres constituants à déterminer. Ces données, quand elles seront complétées, pourront apporter une certaine lumière sur le métabolisme particulier de ces bactéries qui une fois connu, facilitera les recherches sur les moyens pratiques de les éliminer.

Entre temps, on a continué le travail sur les désinfectants pour cette bactérie. Elle est particulièrement résistante à l'action d'un grand nombre. Toutefois il s'est trouvé deux substances connues sur le nom commercial d'Arquad C, un sel quarternaire d'ammonium, et de AM-1120, un sel d'amine, qui sont réellement efficaces dans les conditions du laboratoire. Des essais pratiques de désinfection d'un atelier contaminé seront entrepris aussitôt que possible afin d'éprouver leur efficacité.

Des essais analogues ont été faits sur la "brume", un autre microorganisme — une moisissure cette fois-ci — qui se rencontre en particulier sur le poisson légèrement salé. Cet organisme résiste lui aussi aux désinfectants ordinaires. Bien que le vert Malachite ait donné des résultats satisfaisants, comme mentionné dans un rapport précédent, une nouvelle série de composés chimiques a été essayée. Seulement une seule des huit substances s'est montrée efficace. C'est le AM-1120, mentionné plus haut.

Le séchage artificiel

Il est entendu qu'on peut préparer un poisson séché d'excellente qualité par séchage naturel, c'est-à-dire en exposant le poisson au soleil. C'est de fait la méthode employée depuis plus de 300 ans en Gaspésie, qui s'est fait une renommée, pour bien dire mondiale, dans la préparation du poisson séché type "Gaspé cure". Mais il va sans dire que le séchage naturel est long, sujet aux conditions atmosphériques qui peuvent facilement altérer la qualité du produit si le mauvais temps se prolonge le moindrement et surtout requiert une main d'oeuvre nombreuse. Ce sont là, deux facteurs importants, le temps et la main d'oeuvre, qui contribuent grandement à augmenter le coût de la production. Ces facteurs dans le passé n'avaient pas l'importance qu'ils ont aujourd'hui. Au 20ième siècle, il faut absolument en tenir compte; cette industrie demeurera stable en autant qu'on trouvera moyen de diminuer le coût d'opération en accélérant la production et en diminuant la main d'oeuvre. Un des moyens suggérés, est le séchage artificiel. Pour ce qui concerne le poisson fortement salé, le problème est à bien dire résolu. Mais il reste à mettre à point les méthodes pour le poisson légèrement salé qui présente des difficultés particulières de séchage.

Cette année, on s'est efforcé de compléter l'étude systématique commencée l'an passé sur les conditions de séchage du "Gaspé cure" en tenant compte avant tout de la vitesse de séchage et de l'apparence du produit fini. Les expériences ont été faites à 65°F., 70°F. et 80°F. et aux humidités relatives de 65%, 55% et 50%. Pour ce qui concerne l'apparence du produit fini, la température ne semble pas avoir d'influence, du moins dans les limites étudiées. Mais le taux de séchage augmente sensiblement avec la température; et 80°F. serait la température la plus favorable. L'humidité relative tel que constaté l'an dernier, a aussi une influence, mais seulement au début du séchage; il est d'autant plus rapide que l'humidité relative est plus basse. Mais pour l'apparence du produit final, il est préférable d'opérer à une humidité relative d'au moins 55%.

A titre de comparaison, un séchage continu et un autre intermittant, espacé par des périodes d'empillage, ont été faits dans les mêmes conditions. On a pu constater que le temps de séchage est diminué de 30% dans le deuxième cas et que le taux de séchage, après chaque période d'empillage, est considérablement augmenté. On a cru bon de construire une chambre à air climatisé pour étudier les conditions d'empillage. Les résultats à date ne sont pas complets. Mais les conditions les plus favorables semblent être une température de 55°F. à 65°F. et une humidité relative de 65%. En étudiant davantage ces conditions, il y aurait probablement moyen d'améliorer le produit fini pour le rendre en tout point comparable au produit séché au soleil.

Les expériences citées plus haut, ont été assez concluantes pour permettre un essai sur une base commerciale. A cette fin, une entente a été conclue avec un producteur intéressé. Il a fallu modifier un séchoir commercial déjà existant pour le rendre apte au séchage du poisson légèrement salé, qui exige plus d'énergie calorifique et un plus grand volume d'air que le poisson fortement salé, par suite de la plus grande quantité d'eau à enlever. Quant au séchage lui-même, on a essayé de réaliser les conditions d'opération qui avaient donné les meilleurs résultats au cours des expériences à la Station. Ces essais ont donc été faits à la température de 75°F à

80°F. et à une humidité relative de 55% en autant que possible. Comme le séchoir n'était pas muni d'un système de déshumidification, il a fallu opérer dans certains cas à une humidité plus élevée. Ce qui n'a contribué qu'à augmenter le temps de séchage. Il était surtout important d'obtenir un produit de bel apparence, comparable au produit séché au soleil. D'après les expériences déjà faites, il n'y avait pas de doute qu'on pourrait obtenir un poisson séché au degré d'humidité voulu. Il était donc essentiel d'avoir du poisson frais, bien tranché et de le saler aussi uniformément que possible à une température de 50°F. environ. A cette fin, il avait été convenu que le poisson serait fourni à l'endroit même. Malheureusement, il n'a pas été possible d'obtenir moins de 55°F. pour la température de salage. Quant au salage lui-même, bien qu'on ait employé assez régulièrement 8 lb. de sel par 100 lb. de poisson tranché, il n'a pas été aussi uniforme que désiré. Mais un des plus graves embêtements a été l'impossibilité de se procurer sur place le poisson nécessaire, par suite d'une diminution considérable dans les captures. Pour obtenir les quantités voulues, il a fallu faire venir le poisson de différents endroits. C'est autant de facteurs qui ont contribué à altérer la qualité du poisson.

Malgré tout, les résultats obtenus ont été assez encourageants. Lors des premiers essais, l'apparence du produit fini n'était pas tout à fait satisfaisante. Mais par la suite, la technique a été améliorée et des résultats intéressants ont été obtenus. On a pu faire sortir une légère couche de sel en surface; ce qui est essentiel à la belle apparence du produit fini. Une certaine quantité de poisson a été classé dans les catégories inférieures, mais c'est dû dans une large proportion à des défauts qu'on ne peut pas imputer au séchage; défauts de tranchage, de salage, etc. Ce point a été vérifié en séchant du poisson salé provenant du côté nord de la Gaspésie, où on a la réputation de préparer le poisson avec le plus de soins. C'est en effet avec ce poisson, qu'on a obtenu les meilleurs résultats. Il s'est comparé très avantageusement avec celui séché au soleil.

Afin de vérifier si au point de vue apparence, le poisson séché artificiellement est en tout point comparable à celui préparé au soleil, on a demandé à des classificateurs et à des hommes de métier d'essayer de différencier dans un lot de poisson préparé de différentes façons quels étaient ceux séchés artificiellement. Les erreurs ont été de plus de 30% dans le cas du poisson séché au séchoir commercial et de plus de 60% dans le cas du poisson préparé à la Station. C'est donc dire que l'apparence du produit artificiel peut se rapprocher beaucoup du produit naturel. Les principaux défauts constatés sont: la couleur, quelque peu plus prononcée sur le produit artificiel et la fine couche de sel en surface qui n'est pas toujours égale.

On peut donc affirmer comme conclusion que le séchage artificiel du poisson légèrement salé, type "Gaspé cure" est possible et qu'on peut obtenir un produit fini de bonne qualité, comparable au produit naturel, a condition que le poisson soit bien tranché, en parfait état de fraîcheur au moment du salage, salé uniformément, maintenu à basse température, séché aussitôt que possible une fois le salage terminé et manipulé avec soin pour éviter toute meurtrissure de la chair.

Un des plus grands avantages du séchoir artificiel est de pouvoir commencer le séchage du poisson aussitôt sa sortie de la saumure. Bien souvent, les conditions atmosphériques ne sont pas favorables pour le sécher immédiatement à l'extérieur; tandis que dans le séchoir, le point de rosée ne sera peut-être pas l'idéal, mais suffisamment bas pour permettre le séchage. Rien n'empêche de continuer le séchage à l'extérieur si on le juge à propos quand les conditions deviennent favorables. A l'automne, le séchoir artificiel devient indispensable surtout si la pêche se prolonge comme c'est la tendance actuelle.

Pour se rendre compte des conditions de séchage, surtout au point de vue artificiel, on a installé cette année à cinq endroits différents le long de la côte, des psychromètres enrégistreurs de façon a avoir une bonne idée des conditions atmosphériques de toutes les régions de pêche de la Gaspésie. D'après les résultats obtenus en 1951, le point de rosée pour la moyenne d'une journée n'a pas été supérieur à 65°F. en aucun endroit observé. A cette humidité, le séchage artificiel est encore possible, mais pas très rapide. Les régions les plus favorables sont celle de Cloridorme et de Cap-des-Rosiers. La moins favorable est celle de Grande-Rivière où le point de rosée n'a été inférieur à 55°F. (point de rosée idéal pour séchage artificiel) que 35% des jours et 40% des nuits pendant la saison; tandis que pour Cloridorme on obtenait 87% et 93% respectivement.

<u>Modernisation d'un séchoir artificiel</u>

L'an passé, la Station avait pris une part active à la préparation d'un plan pour la modernisation d'un séchoir commercial de grande capacité; mais le retard dans la livraison de la machinerie n'avait pas permis de vérifier l'efficacité de l'installation. Les tests faits ont révélé que la vitesse d'air est suffisamment constante pour permettre un séchage uniforme. Ce qui était à craindre pour un séchoir de cette dimension. Le volume d'air semble suffisant pour obtenir une vitesse de séchage raisonnable. Comme amélioration à apporter, un certain contrôle d'humidité serait utile surtout pour opération à l'automne où l'air devient souvent trop sec dans le séchoir.

L'huile de phoque

Le travail sur l'huile de phoque s'est continué par l'étude des propriétés physiques des produits hydrogénés. Les principaux usages des produits hydrogénés dans le domaine alimentaire sont les suivants: margarine, shortening, huile à cuisson et huile à salade. On a donc cherché à retrouver dans l'huile de phoque hydrogénée les qualités les plus caractéristiques de ces différents produits.

La stabilité ou propriété de résister à l'action oxydante de l'oxygène de l'air, cause de la rancidité, est une des qualités primordiales des produits alimentaires. L'huile de phoque naturelle même désodorisée ne possède aucune stabilité ; par hydrogénation, l'huile acquiert une certaine stabilité qui s'accroit au fur et à mesure que l'indice d'iode de l'huile est réduit. Les essais ont été conduits suivant la méthode accélérée, c'est-à-dire à température 210°F. avec barbottage d'air. Dans ces conditions, la stabilité de l'huile de phoque se compare avantageusement avec celle du lard hydrogéné. En comparaison, les huiles végétales sont beaucoup plus stables; toutefois, il faut se rappeler qu'elles contiennent des antioxydants naturels qui les protègent contre cette détérioration. Par addition d'antioxydants à l'huile de phoque hydrogénée, on lui communique une stabilité équivalente à celle des graisses végétales. L'huile de phoque semble donc ne présenter aucun inconvénient de ce côté.

Réversion du goût. Ce phénomène qui est indépendant de la stabilité à l'oxygène de l'air se produit dans toutes les huiles hydrogénées; c'est un goût désagréable, différent de celui de l'huile rance, et qui se développe très rapidement dans l'huile désodorisée. Il peut être d'une telle intensité que le produit devient inutilisable en tant qu'aliment. La réversion du goût se produit dans l'huile de phoque hydrogénée, tel que démontré par les tests de dégustations; toutefois la réversion n'est que légère et pourrait passer inaperçue. Il est vrai que les tests furent conduits avec une équipe restreinte et parfaitement au courant des expériences en cours. Ceci peut être une cause suffisante pour jeter un doute sur les résultats et justifier qu'une appréciation impartiale soit obtenue d'une organisation complètement indépendante.

Dureté, plasticité. Le shortening du commerce possède cette qualité de changer très peu de dureté dans l'intervalle de température compris entre la température de la glacière, 50°F. et celle du corps humain, 98°F. La plasticité de l'huile de phoque hydrogénée varie beaucoup plus que le shortening avec le changement de température; c'est un désavantage qu'on peut corriger partiellement en changeant les conditions d'hydrogénation ou encore mieux en effectuant des mélanges de fractions saturées avec des fractions non-saturées. On peut, en changeant les proportions des fractions, altérer à volonté les propriétés physiques des produits.

La margarine, comme le beurre, doit être dure à la température de la glacière, mais doit ramollir rapidement dès qu'elle atteint la température de la chambre. L'huile de phoque hydrogénée remplit parfaitement cette condition, et on peut la trouver même supérieure aux huiles végétales à ce point de vue.

Applications. A la suite de ces expériences on peut prévoir que l'huile de phoque hydrogénée peut être employée comme huile à margarine, huile à shortening ou huile à conserve pour les produits de la mer. Des essais pratiques furent réalisés par la préparation de margarine, de shortening et par mise en conserve de sardines en présence de cette huile. Les graisses ont servi à la préparation de beignes et de patates frites. Tous ces produits furent dégustés et trouvés aussi bon qu'à l'ordinaire.

SERVICE TECHNIQUE

Il est à prévoir, dans un avenir rapproché, des développements importants dans l'industrie de la pêche en Gaspésie par suite de l'introduction de petits chalutiers qui contribueront nécessairement à une augmentation importante des captures. Les ateliers actuels ne sont pas suffisamment aménagés pour répondre à une augmentation de production. Il se présente donc un problème d'organisation de toute première importance. De fait, des demandes d'information sont déjà parvenues sur les possibilités de modernisation des ateliers et de les adapter aux besoins futurs. Pour répondre à ces demandes, des plans de deux types d'ateliers ont été préparés.

Le premier donne les détails d'un atelier de moyenne capacité, mais aménagé de façon à permettre une production variée sans entremêler les différentes opérations. Un espace est prévu pour la production du filet frais et congelé, un autre pour le poisson salé et séché, avec une extension possible pour l'érection d'un séchoir artificiel. Le second indique les détails d'un atelier mécanisé pour une production de filet du triple de la capacité des ateliers en opération. Il est spécialement aménagé pour répondre aux besoins d'une production accrue par suite de l'introduction de nouveaux bateaux de pêche.

La Station a prêté le concours de ses ingénieurs pour la surveillance de l'installation et la mise en opération de nouveaux fumoirs type tunnel, qui deviennent de plus en plus populaires sur la Côte. Deux nouvelles unités ont été mises en opération cette année et d'autres le seront probablement l'an prochain, s'il faut en juger par les demandes d'information reçue à ce sujet.

EDUCATION

The Station has not taken any initiative regarding education. This matter is left in the hands of the L'Ecole d'Apprentissage en Pêcheries. But we are pleased to collaborate with the school. Some lectures dealing with the technology of fish, as last year, were given to different groups of fishermen, foremen of fish processing plant, etc. Series of lectures on advanced Fisheries Technology were presented by the senior staff at the School of Fisheries, Ste-Anne de la Pocatière during the spring term course.

SERVICE TO THE INDUSTRY

At the request of the industry some surveys have been carried out in regard with contamination by red organisms and "dun" in some salt fish plants. Analytical tests have also been made on samples of salt, dried fish, etc. furnished from time to time by the industry.

STATEMENT OF INVESTIGATION

(1) Fresh and Frozen Fish: (Plant sanitation and quality control).

Object: The object of this investigation is the improvement of plant processing methods, plant sanitation, and quality control of fresh and frozen fish.

This work commenced in 1943 and was resumed as the problem developped. The investigations now in progress are expected to be completed within the next three years.

The approximate cost to the end of 1951-52 is $79,000.00; the estimate expenditure for 1952-53 is $15,000.00.

Results: Plans for standard filleting plants and processing equipments adapted to the needs of the Gaspé Coast have been designed. A brine bath of a special design has been experimented to reduce the drip of frozen fillets. Control of quality of fresh and frozen fillets has been carried out in collaboration with provincial fishery inspectors.

Plans for 1952-53: Important fishing development in fresh and frozen fish industry is foreseen for next year on the Gaspé Coast. The Station will pay great attention to the problems which these expansions will involve, particularly in regard of modernization and layout of fish plants. Filleting tables and processing equipment have to be modified to adapt to larger production. A systematic survey of the quality of the fillets produced in this new processing plant will be carried out and remedial measures applied if necessary. The control of quality of fresh and frozen fillets will be continued as in the past with the collaboration of the fishery inspectors. This programme will represent an increase of about $7,000.00 for next year.

(2) Smoked Fish:

The object is to improve method of smoking of different fishes as salmon, mackerel, sturgeon, eel, in order to prepare attractive product and also to increase the efficiency of the tunnel smoke-house if required. This investigation started in 1948 with the construction of a smoke-house of reduced model. The programme is expected to be completed in two years.

The approximate cost to the end of 1951-52 is $32,000.00; the estimate expenditure for 1952-53 is $7,000.00.

Results: The smoke generator has been improved in order to reduce the time of smoking. Methods for smoking sturgeon and mackerel have been investigated.

Plans for 1952-53: To continue the investigations now in progress, specially in finding proper method for smoking salmon and eel; to improve the method of salting and dripping after soaking in order to improve the smoking itself. Make some tests to determine the smoke density most favorable to accelerate the smoking operation. This programme will involve the same expenditure as last year.

(3) Salted Fish: Light salted fish, type Gaspé Cure.

Object: The investigation on salting and drying of fish with particular reference to light salted fish, type Gaspé Cure, has been undertaken since 1943 at the Gaspé Station. The biochemical, bacteriological and engineering aspects of that problem have been studied with the object of elucidating the mechanism involved in the preparation of salted fish and thus to find methods for obtaining a uniform product possibly superior in quality to that presently prepared.

The approximate cost of this investigation to the end of 1951-52 is $233,000.00 and the estimate cost for 1952-53 is $45,000.00. It is nearly impossible to give an idea of the length of the programme in years as always new problems arise with the progress of the investigation.

Results: The results obtained up to the present time do not permit us to draw definite conclusions on all the problems involved in the preparation of light salted fish, but the data on hand show that the light salted fish, type Gaspé Cure, consists of a gel of protein peptized by the action of salt at low concentration which gives the characteristic amber color. The study of salt and water exchange has led to some practical applications. We know how much salt we should use to obtain a specific cure. For Gaspé Cure about 8 lbs. of salt for 100 lbs. of fish are necessary. This was confirmed by experiments on pilot plant scale. The study of the characteristic constituents of light salted fish by the method of paper chromatography is now under investigation.

The bacteriological work of the Gaspé Cure codfish has consisted firstly in following quantitatively the change in bacterial flora during the commercial preparation and in determining the effect of increasing salt concentration on the original flora. It was found that the genus Micrococcus always predominates.

The culture media for red organisms was improved so that growth was obtained after 48 hours incubation. The study of the constituents of red organisms by the method of paper chromatography is under way.

Some quarternary ammonium compounds and amine salt were found effective to inhibit the growth of red organisms and "dun".

The engineering aspect of the problem has dealt principally with the artificial drying and with the storage conditions for keeping quality of the finished product. A complete investigation on artificial drying of codfish was undertaken in order to make a comparative study of the best drying conditions for each kind of salted fish. With heavily salted fish best results were obtained with temperatures of 80°- 82°F. and relative humidities of 50-55%; with light salted fish, temperature of 75-80°F., and relative humidities of 55-60% were found the best favorable. The experiments on pilot plant scale have shown that the artificial drying of light salted fish is feasible. Good quality of fish could be produced by experienced men.

An important part of our activities for the last two years was devoted to the study of the keeping quality of dried salted fish exported to Southern countries. In brief, the results obtained have shown that the highest safe storage conditions for every kind of dried fish are a temperature of 80°F. and a relative humidity of 70%.

For over ten years a record of temperature and relative humidity has been taken at Grande Rivière in relation to the drying of fish.

Plans for 1952-53: To continue the study of the characteristics of light salted fish, type Gaspé Cure, by the method of paper chromatography and also other type of light salted fish as Newfoundland Shore Cure, Labrador Cure, etc.; to investigate a new method of salting in order to obtain an uniform product and eliminate, if possible, the error due to the salter himself; to study during the salting the influence of temperature on "sliming".

To study by the method of paper chromatography the biochemical properties of bacteria isolated from Gaspé Cure to determine their action in this particular curing; a similar study of the bacterial flora of other type of light salted fish; to continue the study on red organisms and "dun" with the objective to find a practical means to inhibit their growth.

To complete the study of the artificial drying of light salted fish, type Gaspé Cure, and also other type;

based on the results obtained, make calculation for the energy and volume of air required to dry particular kinds of light salted fish and design a dryer accordingly; the action of infra red and ultra violet rays and high frequency on drying of salt fish; to study the storage conditions of the finished product.

Although the salt fish investigation will remain the most important topic of our programme, there will be a decrease in the cost of about $9,000.00 for 1952-53 due to the fact that the experiment on pilot plant scale which was rather expensive, will be nearly completed. New investigations will not involve as large expenditure as the one this year.

(4) <u>Seal Oil Investigation</u>:

<u>Object</u>: This investigation was started with the purpose of exploring several of the possible uses of this oil so as to increase its commercial value. Seal fishery is of considerable importance to the Gulf of St. Lawrence and North Shore of the St. Lawrence River and practically no work has been done on seal oil. At the request of the Department of Reconstruction, this investigation was planned in 1946.

Approximate cost to the end of 1951-52 is about $109,000.00; the estimate cost for 1952-53 is $26,000.00. This project is expected to be completed in about 3 years.

<u>Results</u>: Physical and chemical characteristics of seal oil have been studied. Methods of sulfatation have been investigated. A temperature of reaction below 105°F. was found to be necessary for best results. Washing to as near neutrality as possible was found to prevent formation of free fatty acids during settling.

<u>Refining and bleaching</u>: By using a solution of caustic soda of proper concentration, it was found possible to remove a large portion of the color of the oil while removing the free fatty acids entirely. A simple treatment with bleaching clay helped to remove still another portion of the color. No particular advantage seemed to be gained by the use of chemical agents.

<u>Deodorization</u>: By employing the usual methods of operation (steam distillation under vacuum) a tasteless and odorless oil may be obtained from rancid seal oil. The deodorized oil has a stability of about 20 days at 40°F. which makes it unsuitable for use as a salad or canning oil. The use of a temperature of 480°F. or higher favors polymerization of the oil.

<u>Hydrogenation</u>: On account of the importance of the hydrogenation in fat and oil industry, this process has been investigated thoroughly. Seal oil has been satisfactorily transformed into stable products suitable as salad oil, margarine oil, and shortening oil, without blending with other oils. The reaction offers no difficulty other than the customary ones and the process should be not much more costly than for vegetable oils.

<u>Plan for 1952-53</u>: To continue the work on hydrogenation, particularly at higher pressure, with different grades of oil; to continue the study of flavor reversion; make test of stability of oil with or without antioxydants; to study the segregation of seal oil and carry out hydrogenation on different fractions of the segregated oil to extend this investigation to other marine oil as cod liver oil, etc.

With the return of Mr. Cardin, to carry out research work on the chemical constitution of marine oils of different origins and the fatty acids of those oils.

To investigate the thermal polymerization with and without blowing and the characteristics of polymerized oil.

The amount required for 1952-53 will represent an increase of about $7,000.00. This is due mostly to new equipment required for the continuation of the above programme and also to the fact that Mr. Cardin, who was on educational leave, will return to the Station in 1953.

This programme is rather preliminary and is subject to revision according to decisions with regard to the whole programme of the Board on marine oil.

(5) <u>Minor Investigations</u>:

<u>Object</u>: Particular investigations requested from time to time by fish processors. Analytical service to the Trade as requested.

Approximate cost to the end of 1951-52 - $23,500.00; estimate cost for 1952-53 - $2,300.00.

<u>Results</u>: Tests of purity of salt; nutritive value of seal liver; new method of packing dried capelan; method of freezing and glazing cooked lobster.

<u>Plan for 1952-53</u>: Continuation of the analytical service to the Trade as required. Determining the quantity of sodium nitrite to be used for making antiseptic ice and testing the efficacy of such ice.

Statement of investigation costs and personnel after allocations of cost of administration and maintenance.

Investigations	Actual 1950-51	Further period	Cost			Per-son-nel
			To end 1950	1951 1952	Estimate 1952-53	
Fresh & Frozen Fish	1944-52	1955	71,000.	8,000.	15,000.	4
Smoked Fish	1948-52	1955	25,000.	7,000.	7,000.	3
Salt Fish	1940-52	ind.	179,000.	54,000.	45,000.	8
Seal Oil	1947-52	1956	85,000.	24,000.	26,000.	4
Miscellaneous	1944-52	--	21,000.	2,365.	2,300.	3
				$95,365.	$95,300.	

PURPOSE OF EXPENDITURE

The figures given show costs after allocation of expenditures for salaries, wages, equipment, etc. to the purposes listed.

Purposes	Actual 1950-51	Anticipated 1951-52	Preliminary estimates 1952-53
Administration	12,350.00	14,754.00	15,325.00
Building & Ground	19,730.00	24,733.00	25,074.00
Fresh & Frozen Fish	4,600.00	3,200.00	9,730.00
Smoked Fish	4,100.00	3,060.00	3,256.00
Salted Fish	20,600.00	33,068.00	24,490.00
Seal Oil	13,500.00	14,470.00	14,945.00
Miscellaneous	1,365.00	2,078.00	2,480.00
Total:	$76,245.00	$95,363.00	$95,300.00
Capital expenditure			
Construction of sea wall	8,716.00	--	--

GASPE FISHERIES EXPERIMENTAL STATION

1 9 5 1

SCIENTIFIC STAFF

A. Nadeau, B.A.,M.Sc.,D.Sc.,F.C.I.C.	Ac. Director
H. Fougère, B.A.,M.Sc.,Ph.D.,F.C.I.C.	Biochemist (to March 31) Senior Biochemist (from April 1)
L.C. Dugal, B.Sc.,M.Sc.,D.Sc.,A.C.I.C.	Biochemist (to March 31) Senior Biochemist (from April 1)
H.P. Dussault, B.A.,B.Sc.,M.Sc.	Assist. Bacteriologist
R. Legendre, B.A.,B.Sc.App.,M.Eng.	Assist. Engineer
L. Riou, B.A.,B.Sc. (resigned)	Assist. Chemist
A. Cardin, B.A., B.Sc.,M.Sc. (on educational leave)	Assist. Chemist
C.A. Olivier, B.A.,B.Sc.,D.Sc.	Assist. Organic Chemist
R.A. Lachance, B.Sc.,M.Sc.	Assist. Bacteriologist
H. Dupuis, B.Sc.App.,M.Eng. (resigned)	Assist Engineer (May to September)
A. Domnas, B.Sc.	Sen. Res. Ass. (seasonal) (May 15 to Sept. 9)
R. Lanthier	Jun. Res. Ass. (seasonal) (May 15 to Sept. 7)

NON-SCIENTIFIC

J.B. Bérubé	Technician G.1 (since April 1)
R. Cauchon (resigned)	Ass. Technician G.3
J. Thibodeau (Miss)	Jun. Lab. Assist. G.2
R. Dubé	Administrative Assistant
Y. Lavoie (Miss) (resigned)	Clerk G.2A
H. Berthelot (Miss)	Clerk G.2A (since April 1)
C. Chartré	Maint. Supervisor G.4
E. Roussie	Maint. Supervisor G.2
Y. Lambert	Caretaker G.3
N. Diotte	Caretaker G.2
G. Duguay	Caretaker G.2

INVESTIGATORS' SUMMARIES

S E C T I O N I

SALT FISH

Appendix No. 1

THE IDENTIFICATION OF THE AMINO ACIDS OF CODFISH PRESS JUICE

Paper partition chromatography has proved to be an easy and rapid method for the identification of the amino acids. Since further work is planned on codfish muscle press juice using the previously mentioned method, it was essential that a procedure be standardized for use in future investigations. Using this above mentioned method it was proposed to identify the amino acids of muscle press juice and to determine which ones exist in the free or bound state.

The method of Consden and co-workers was used for chromatography, using the ascending capillary modification as proposed by Williams and Kirby. Solvents used were Mallinckrodt phenol, 80% for the first dimension, followed by collidine (1 part 2-4 lutidine; 1 part 2-4-6 collidine; 2 parts water) in a second dimension. Whatman filter paper No. 1 was used throughout.

Free Amino Acids: For chromatography codfish muscle press juice was prepared in the following manner. Five ml whole juice was pipetted into 10 ml of 95% alcohol and allowed to stand for 10 minutes. (This usually precipitates all the proteins and when using salted samples, removes a good deal of the NaCl which hinders clear separations of amino acids). The mixture was centrifuged and the clear supernatant poured into another portion of 10 ml 95% alcohol and once again allowed to stand for 10 minutes. This mixture was then centrifuged, 5 ml of the clear supernatant taken and concentrated on the water bath until almost dry. Five ml of alcohol were added, the mixture centrifuged to remove solid matter and the supernatant was then taken and concentrated on the water bath until 1 ml remained. Quantities of 20 to 50 microliters were taken from the mixture for chromatography.

Hydrolysate: One half ml samples of whole cod juice were placed in ampoules and 2 ml of appropriate hydrolyzing agent were added (6 N H_2SO_4 or 6 N NaOH). The ampoules were sealed and placed in an autoclave and heated for a period of 6 hours under a pressure of 12 lb. At the termination of this time the ampoules were removed, broken open, and the contents were transferred to an Erlenmeyer flask where the excess hydrolyzing agent was neutralized using H_2SO_4 or NaOH as the case required. The Na_2SO_4 so formed was then removed by two portions of 20 ml 45% alcohol. The solutions were then filtered, transferred to 50 ml volumetric flasks and made up to the mark with 95% alcohol. From this solution,

TABLE I

Amino acids of codfish muscle press juice

Amino Acid	Free	Hydrolysate
Aspartic acid		+
Glutamic acid	+	+
Glycine	+	+
Serine		+
Threonine		+
Taurine	+	+
Cysteic acid		+
Alpha-alanine	+	+
Beta-alanine	+	+
Alpha aminobutyric acid	+	+
Valine	+	+
Leucine and or Isoleucine	+	+
Methionine		+
Methionine SO		+
Histidine	+	
Proline	+	+
Arginine	+	
Tyrosine		+
Lysine	+	

aliquots of 5 ml were taken and concentrated on a water-bath until 1 ml remained. Forty to 80 microliters were taken for chromatography.

<u>Results</u>:

The results are shown in table -1-

Twelve amino acids were found existing in the free state. Of particular interest is the absence of aspartic acid as a free amino acid. This characteristic has been noticed by other workers in their investigations on rat and human skeletal muscle extracts and in carp muscle extracts.

The presence of alpha aminobutyric acid is also noticed and is the subject of much speculation. This substance may arise from two precursors, i.e. glutamic acid and methionine. Since methionine has not been found in the free state nor the presence of methionine sulphoxide detected, there is a possibility that the alpha aminobutyric acid present may have arisen from methionine. Glutamic acid can be a precursor of alpha aminobutyric acid, since the action of strong NaOH leads to the decarboxylation of glutamic acid. However, this possibility occurs only in the case of hydrolysis. It has also been noticed that in absolutely fresh carp tissues, alpha aminobutyric acid appears only after six hours of decomposition. This fact would tend to show that alpha aminobutyric acid is not a naturally occurring amino acid in normal fish tissues.

Large quantities of beta alanine and histidine were found in the free state indicating the presence of carnosine, a dipeptide consisting of these two amino acids.

Phenylalanine and tryptophane are difficult to locate using collidine solvents since the positions normally occupied by these substances are overlapped by the leucines. The applications of special recommended tests led to inconclusive results. The presence of cysteic acid and methionine sulphoxide in the hydrolyzates showed that these two substances were oxidized either in hydrolysis or under the conditions of chromatography employed. Tryptophane has nevertheless been identified by chemical tests. Arginine, lysine and histidine are missing from hydrolyzates indicating their probable destruction. These results indicate the presence of 7 bound and 12 free amino acids in fresh codfish muscle press juice.

H. Fougère
A. Domnas

, Appendix No. 2

THE EFFECT OF SALT ON THE AMINO ACIDS OF CODFISH MUSCLE PRESS JUICE

In appendix 8, 1950 the effect of salt on the free amino nitrogen in codfish muscle press-juice was reported. At the time a peculiar behavior of the amino nitrogen was suspected and left to further investigation. As a result with an improved sampling technique seven experiments were carried out with relatively consistant results.

Codfish muscle press-juice was prepared so that solutions were made corresponding to 6%, 8%, 10%, 12%, 14%, and 16% salt by weight. At 24 hour intervals, an aliquot of each was centrifuged, 10 ml. of the supernatant were added to 10 ml. of 10% trichloracetic acid and well shaken. After 10 minutes standing the samples was centrifuged and finally filtered to do away with any trace of suspended protein. A 10 ml. sample of each filtrate were taken and analysed for amino nitrogen by the copper method of Pope and Stevens. The results are expressed as mg. per 100 g. of fish juice.

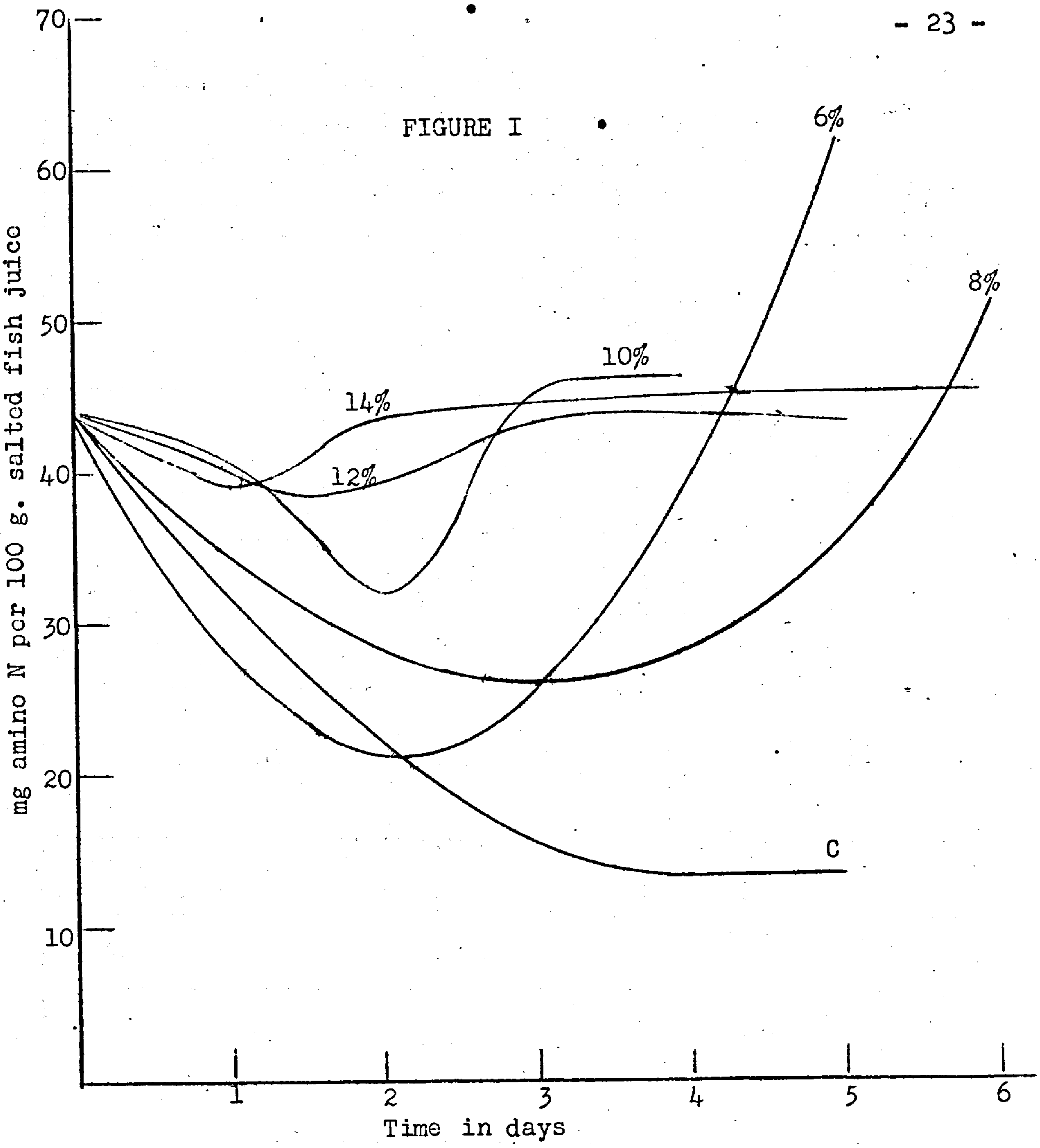
Qualitative analysis of amino acids was carried out simultaneously by paper partition chromatography. The solvents were 80% phenol for the first dimension followed by collidine for the second dimension. The samples followed were the control, 10% and 16%.

The disappearance of amino nitrogen in fresh fish juice has been investigated by Beatty and Collins who propose deamination by bacteria as the principal mechanism. The effect of varying concentrations of salt on the free amino nitrogen is shown by the curves in figure 1.

In the case of the control sample, the values for amino nitrogen drop regularly and rapidly in almost a linear function for four days. When salt is added to the juice as in the case of 6%, deamination is retarded slightly, but the general shape of the curve up to 3 days follows closely that of the control. At the end of the third day, the amino nitrogen rises sharply and may attain values of 95 mg per 100 g of fish juice. It appears that salt in this case, has a stimulating effect on the reappearance of amino nitrogen. The 8% salt solution shows much the same characteristics, except that the rate of both deamination and reappearance of amino nitrogen is retarded. The main similarity in all the cases studied is the fact that deamination occurs varying in intensity with the salt concentration.

It must be pointed out however that there is a marked difference as to the effect of salt on the rate of

FIGURE I



The fate of amino nitrogen in codfish muscle press-juice of 6% to 14% salt concentration.

deamination and also on the subsequent rise of the amino nitrogen between 8% and 10%. Below 10%, deamination is much more rapid and the rise of the amino nitrogen in the latter stages much more pronounced than in the samples of 10% and higher.

TABLE 1

Amino Acid \ Days	Control						10%						16%					
	1	2	5	6	7	8	1	2	5	6	7	8	1	2	5	6	7	8
Glutamic Acid	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Glycine	X	X					X	X	X	X	X	X	X	X	X	X	X	X
Serine																	X	
Threonine										X	X	X					X	
Taurine	X	X	X X	X X	X X	X	X	X	X	X	X	X	X	X	X	X	X X	X
Alpha-alanine	X	X					X	X	X	X	X	X	X	X	X	X X	X	X
Beta-alanine	X	X	X X X	X X X	X X	X	X	X	X	X	X	X	X	X	X	X	X	X
Alpha amino-butyric acid	X	X					X	X		X	X	X	X	X	X		X	X
Valine	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X
Leuceine Isoleucine	X	X	X	X X	X X	X	X	X	X X	X	X	X	X	X	X	X	X	X
Histidine	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X
Proline	X	X	X				X	X	X	X	X	X	X	X	X		X	X
Arginine	X												X	X			X	
Tyrosine								X	X	X	X	X			X			

The disappearance or maintenance of amino acids in salted codfish muscle press-juice.

From table 1, it can be seen that the amino acids undergo certain changes. Particularly in the control sample, it is clearly evident that at least seven of the amino acids which were present at the beginning of the experiment have disappeared. At the end of this time only four have remained, namely, very slight traces of glutamic acid, taurine which seems to be particularly resistant to any change, beta alanine and the leucines. Here then, coupled with the quantitative evidence, is the fact that one knows which amino acids have disappeared.

When examining the effect of 10% salting, it appears that the amino acids undergo no change, but it must be pointed out that the chromatographic technique employed is not quantitative, and no matter if any particular amino acid is in the process of disappearing a spot will appear on the paper as long as some of the acid remains in the sample. However the varying intensity of the spots as observed day by day offered a method of approximating a quantitative change in any one particular acid. This is described in the figure by the sign "X". The signs increase in number with increased intensity of the spots as compared roughly with a standard solution of alpha-alanine. In the control sample some amino acids have disappeared entirely, a process which can be recorded chromatographically. In the 10% sample however we must accept the conclusions derived from figure 1, and further add that some amino acids are deaminated but none disappear entirely. Actually, the protein substrate of the 10% sample undergoes a certain degree of hydrolysis, since there are two more amino acids at the end of the experiment, these being tyrosine and threonine.

In the case of 16% salting, much the same occurrences are noted as in the 10% salting. Serine, threonine and arginine appear transitorily and tyrosine appears but once. It is evident that the salt concentrations have a particular role in the preservation of the amino acids in fish juice.

These results tend to show that in these samples two mechanisms are operating simultaneously; one is deamination and the other hydrolysis, the latter being stimulated by the presence of sodium chloride.

H. Fougère
A. Domnas

Appendix No. 3

INVESTIGATIONS ON THE BEHAVIOUR OF KETO-ACIDS IN CODFISH MUSCLE PRESS JUICE

A previous appendix has shown that amino acids in codfish muscle press juice undergo changes resulting in a loss of amino nitrogen. The mechanism proposed to explain this loss was deamination. It was reasoned, therefore, that if deamination was truly occurring in the juice, then a consequent increase in keto-acids should be observed. Inspection of the following equation, which has been proposed as the method wherein deamination occurs, shows that the amino acid, alpha-alanine becomes alpha-keto-propionic acid or pyruvic acid.

Oxidative deamination

$$\underset{\text{alpha alanine}}{CH_3-\underset{\underset{NH}{|}}{CH}-COOH} \longrightarrow \underset{\text{imino acid}}{CH_3-\underset{\underset{NH}{|}}{C}-COOH} \longrightarrow \underset{\text{alpha keto propionic acid}}{CH_3-\underset{\underset{O}{\|}}{C}-COOH}$$

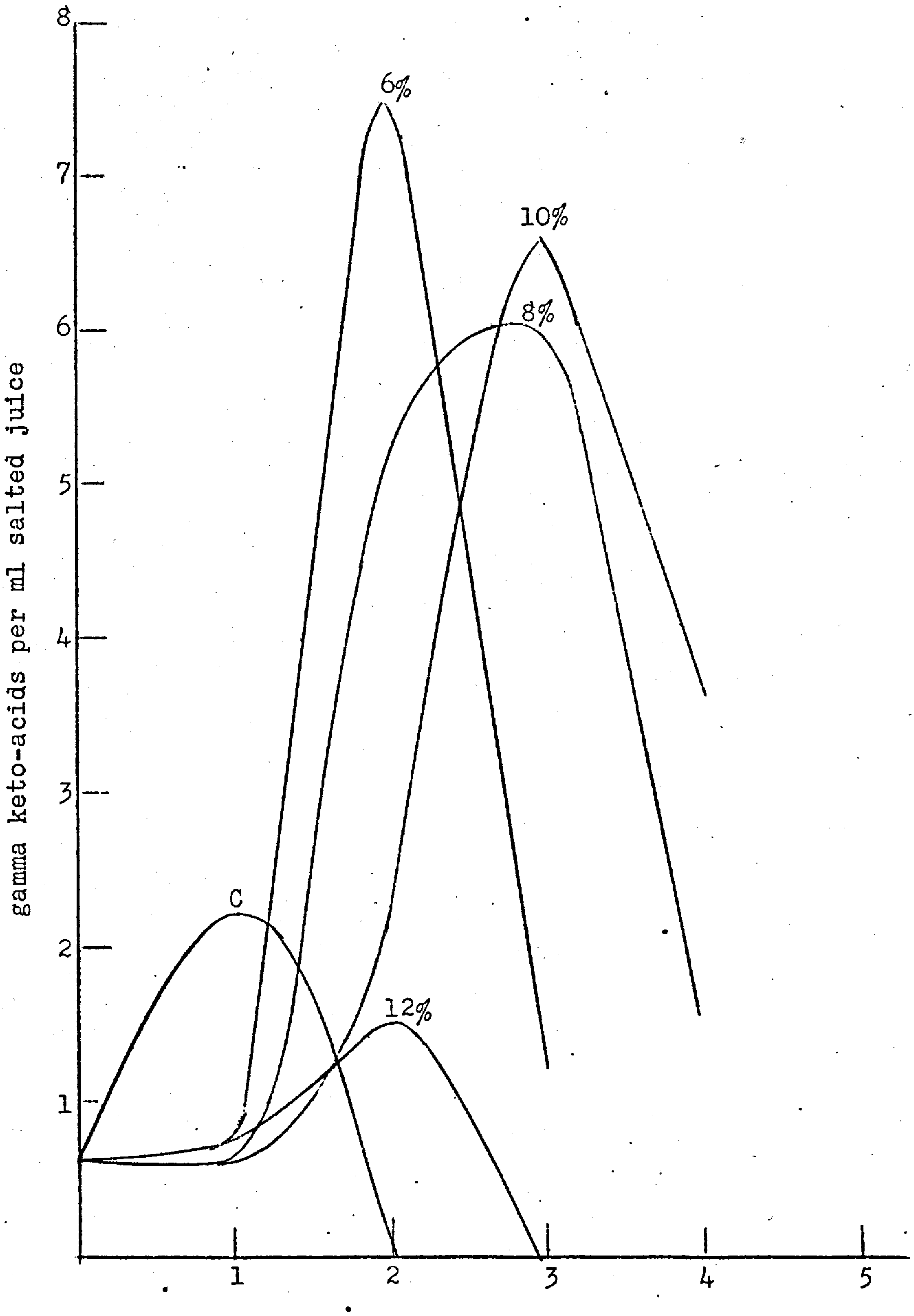
It is also known that such products of deamination are normally incorporated into the tricarboxylic acid cycle, but the same cycle would not exist in fish juice. However certain primary stages could be present in the juice before inhibition of the enzyme systems, pH changes, and, or disruption of the normal state of activity by bacteria.

In this investigation it is proposed to study the behaviour of the keto acids in codfish muscle press juice salted at different concentrations.

Codfish muscle press juice was prepared and salted as previously described, for different concentration levels (see appendix No. 2). The press juice was centrifuged, 10 ml of the clear supernatant pipetted into 10 ml of 10% trichloracetic acid. This mixture was centrifuged, filtered and 3 ml of the clear liquid was taken and prepared for analysis according to the method of Friedemann and Haugen (J. Biol. Chem. 147, 415-441, 1943).

The results are shown graphically in figure 1, and are expressed as gamma keto-acid expressed as pyruvic acid per ml fish juice. From the figure it can be seen that the

FIGURE I



The fate of keto-acids in codfish muscle press-juice of 6% to 12% salt concentration by weight.

keto-acids increase with time, reach a maximum and then drop to practically nil. In the case of the control, the values of keto-acids reach a peak on the first day and then drop to zero on the second day. Similarly, the curves for 6%, 8%, 10%, 12% show much the same trends. If however one compares these curves with those obtained for deamination (appendix 2), one can see that the results compare inversely. Where a maximum is attained for keto-acids, a minimum is shown to occur for the amino acids. It is interesting to note that the curve representing 12% does not show a great quantity of keto-acid at its maximum value. A glance at 12% salting for amino acids shows but a slight deamination. Hence the main point is shown quite well, that if deamination occurs then the consequent rise in keto-acids can be explained.

The question is asked however as to why the keto-acids disappear. Here one is faced with two possibilities, (a) that the keto-acids are being reaminated and, (b) that the keto-acids are being further degraded. Of the two cases the former has perhaps more attraction. The keto-acids disappear simultaneously with the reappearance of the amino acids. Further studies will be carried out by determining peptide nitrogen and its mode of action.

Recent studies in this laboratory have indicated the presence of pyruvic acid at the onset of decomposition of both fresh and salted fish and forms a part of the volatile acid constituents of fish as determined by the distillation method.

H. Fougère

Appendix No. 4

THE PREPARATION OF GASPE CURE

Beside a few minor details which should be clarified the preparation of Gaspé Cure is no more a problem for this laboratory.

This year, based on a logical adaptation of known facts gathered here and there by observation and coupled with the experimental data already on hand, several thousand pounds of fish were cured by the pickle method of salting and sun drying. Stress was laid particularly on the quality of the fish which could be obtained as affected by the weight of salt used per 100 pounds of fish, by the temperature at which the fish was salted and the prevailing outside drying conditions.

No criteria for quality other than the judgement of an experienced person and the comparison made with the product of other establishments were used. The writer was assisted for a period of two months by a man of 35 consciencious years of experience in salting and drying Gaspé Cure. As a result of an agreement, his demands were Gaspé Cure of the finest quality. We were also afforded to observe if, under similar drying conditions, it were possible to produce a fish of better quality than is generally produced in establishments situated in the same locality as the Experimental Station.

Weight of salt used

These experiments were carried out at 15°C.

Batches of 200 to 300 pounds of fish were salted with weights of salt varying between 6% to 16% by weight of the fish. These experiments were more or less a repetition of the ones that are described in appendix 9, 1950 of this station's annual report. They were nevertheless justified since they confirm the previous ones and add slightly more in results.

The all round experience gathered by these experiments reveals that 10 pounds of salt is the optimum weight which can be added to 100 pounds of split fish in order to obtain a finished product which will look in some ways similar to Gaspé Cure. Generally speaking, the quality is far from being desirable. After 5 days in brine when equilibrium in salt and water transfer has practically been established the ambiant brine is 12% concentrated. Theoretically speaking, on the basis of personnally conducted laboratory experiments and on the basis of Dyers experiments on myosin (Atlantic Fisheries Experimental Station) it stands to reason that the main protein constituents of the fish are denatured. When the fish is dried the surface appearance is not exactly that of salt burn but nearly so.

Any quantity of salt greater than 10 pounds per hundred pounds of split fish does not produce Gaspé Cure, at least under our presently adopted method of procedure. The product will invariably turn out to be partially or totally salt burn.

What then, on the other hand, is the least amount of salt than can be added to fish in order to obtain a product of at least reasonably good appearance? This was found to be 6 pounds of salt per 100 pounds of fish. However, under these conditions the fish cannot remain in pickle until equilibrium of salt and water transfer is established.

This takes at least 5 to 6 days and the fish shows signs of decomposition after 3 to 4 days. At the end of two days the fish is still in a good state of preservation. Its salt content on the dry weight basis is roughly 14%. When properly dried, the finished product is of excellent quality. But, when smaller quantities of salt are used the dried product is too hard and has a tendency to curl up. Moreover its low salt content makes it very susceptible to spoilage, a condition which must be taken into account during the initial drying periods.

Therefore 6 to 8 pounds of salt per 100 pounds of split fish are considered the ideal quantities to be used for the successful pickling of Gaspé Cure at 15°C. To be on the safe side however it is recommended to advise the use of 8 pounds.

Temperature

Salting at temperatures between 5°C. and 20°C. showed no appreciable difference in the quality of the finished product. At 5°C. the salt penetrates much more slowly and therefore the fish must remain longer in pickle. However 10°C. has been found to be a practical salting temperature, because sometimes, on account of unfavorable drying conditions, the fish cannot be taken out to dry and can remain in salt bulk in cold rooms for at the most another day without serious consequences. But, on the basis of strict economy and on the rate at which pickle is formed 15°C. is an excellent salting temperature when artificial drying is practiced.

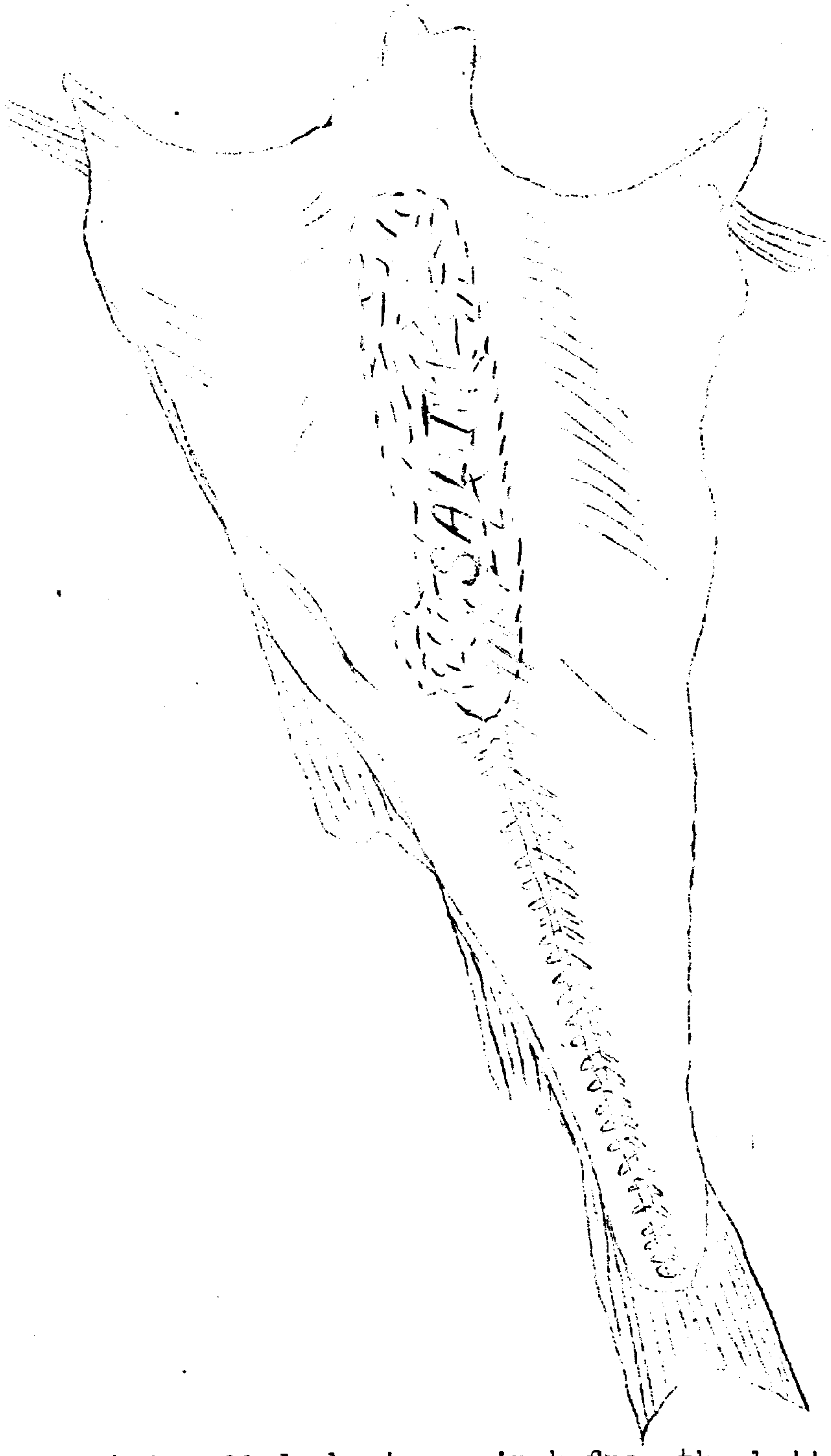
Salting

The fish was salted in tubs 30 inches in diameter and 30 inches high. Molasses puncheons cut in two make excellent size tubs for this purpose. The fish was laid in tier, flesh side up and the salt added about one inch from the butt down following the flesh part where the soundbone had been removed and including a few of the remaining vertebrae as illustrated. This procedure was repeated until the tub was full. No salt was added to the napes. After 24 hours, the fish was weighed down with flat stones in order to keep it submerged in its brine. After a period of 48 hours it was removed from the tub, washed in its own brine, water-horsed for 5 to 6 hours then immediately spread on the flakes to dry.

It was found out that it was not necessary for the fish to remain in pickle any longer than 48 hours although it could remain 72 hours, but not much more.

Normally a fresh fish is slimy and has a tendency to slip out of the hand when taken by the tail end. An ex-

FIGURE I



The salt is added about one inch from the butt down, following the flesh part where the soundbone has been removed and including a few of the remaining vertebrates.

cellent guide whereby a fish salter may know when to take the fish out of the pickle is to pick up a few of the fish by the tail end. If they are still slippery they must remain longer in pickle, if not, that is, if they can be held in the hand without any tendency for them to slip away, they may be taken out and water-horsed. This condition is attained normally after two days in pickle.

This year some 2500 pounds of fish were salted by this method. The salting was done by the writer. The drying and all operations leading to the finished product were left to the care of his experienced helper. Some 900 pounds of finished product were obtained and culled by two government inspectors. As a result 95% were classified as select and choice and the 5% standard.

The weather conditions for drying this fish were identical to those at the fish plants in our immediate neighborhood where the classification of their finished product was the inverse of what we had obtained.

As a result of these experiments it was concluded that although the preparation of Gaspé Cure may be considered in general as a lost art, there still remain in this region a few individuals whose knowledge has been indispensable in confirming our theories resulting from experimental work.

Those who so far have followed our directives in preparing Gaspé Cure have done well; the others remain in the category of low quality producers, signifying that they ignore the reasons for the various steps which should be undertaken for successful operations.

H. Fougère

Appendix No. 5

STERILIZATION OF FISH JUICE AND FISH MUSCLE WITH ETHYLENE OXIDE

Realizing the importance of obtaining sterile fish juice and fish muscle for certain types of bacteriological studies, sterilization by glycol vapors had been attempted and reported in the 1950 Annual Report (appendix No. 17). However, treatment of fish muscle with ethylene glycol and propylene glycol vapors had proved wholly inefficient. Our studies were resumed by attempting the application of ethylene oxide in the liquid form for the sterilization of fish juice and fish muscle.

In his work dealing with the bactericidal action of various chemical compounds on fish spoilage bacteria, Tarr (J. Fish. Res. Bd. Can. 6 (3) 1944) tried ethylene oxide and reported a pronounced decrease in the number of bacteria although complete sterilization was not obtained. In an earlier study, Wood (Unpub.) found that he could obtain fish muscle which was bacteriologically sterile by treating it with ethylene oxide gas in vacuo. However, explosive hazards being involved, the latter method was never put to practical use. Recent investigators have proposed a method by which culture media could be sterilized by ethylene oxide without producing any apparent alteration in the biological or biochemical composition of the medium. Their method has been applied to the sterilization of fish juice and fish muscle.

I - Sterilization of fish juice:

Fish juice was obtained in the usual manner by pressing minced codfish muscle and coarse-filtering on glass wool. Liquid ethylene oxide was added under refrigerated conditions in order to avoid loss and danger caused by vaporization. Varying concentrations of the oxide were tried for varying intervals of contact time at low temperature. After allowing the stoppered flasks containing the fish juice samples to refrigerate for one hour, they were placed in the incubator at 37°C. for 24 hours in order to liberate all traces of ethylene oxide by evaporation. The oxide concentrations tested were 0.5, 1.0, 1.5, and 2.0 per cent.

The original bacterial count on the fish juice had showed 7.2×10^5 bacteria. per ml. After 48 hours incubation at 37°C., the flasks were examined. It was noticed that in every flask the fish juice had taken a creamy white appearance with a soft curdle consistency independently of the amount of ethylene oxide added. Organoleptic tests were also made and showed that the untreated flask kept as a control liberated a very strong and pungent smell. The sample treated with 0.5 per cent ethylene oxide only had a mildly putrefactive odor while at the other concentrations, the clean smell of fresh fish was noticed. Sterility tests were also made by transferring loopfuls of the curdle into tubes of nutrient broth and unto the surface of nutrient agar. After 24 hours incubation, all concentrations above 0.5 per cent, showed complete sterility, indicating effectiveness of the treatment. Similarly effective results were obtained when oxide treatment was made on spent brine from pickled fish, indicating that the presence of NaCl, even in high concentrations, does not cause any interference.

In order to determine if the ethylene oxide treatment affected the biochemical composition of the fish juice for subsequent bacteriological assays, the free amino acid composition of both treated and untreated fish juice was studied by paper partition chromatography. The same amino acids in approximately identical concentrations were found i.e. aspartic acid, glutamic acid, glycine, serine, threonine, taurine, alpha-alanine, beta-alanine, alpha-aminobutyric acid, valine, leucine and /or isoleucine, methionine sulfoxide, histidine, proline, arginine, tyrosine and lysine. These results would show that the nutritional value of fish juice for bacteria has not been altered by the ethylene oxide treatment. However, the difficulty created by the coagulation of the fish juice definitely is an interference in the utilization of sterile fish juice as a liquid bacteriological medium.

II - <u>Sterilization of fish muscle</u>:

Although repeated experiments have proved that fresh fish muscle is bacteriologically sterile, the methods proposed for its extraction are so cumbersome and risky that they have not yet found a practical utilization in the laboratory.

The sterilization of fish muscle has been attempted by immersing pieces of fresh fish tissue, approximately one square inch by 1/2 inch in thickness, in ethylene oxide solutions of varying concentrations for varying periods of time. For the same reasons as mentioned above, refrigerated conditions were established. The concentrations used were 1, 2 and 3 per cent. During immersion of the pieces of fish muscle in the ethylene oxide solutions intermittent agitation was produced for the purpose of insuring good distribution and effective contact.

The pieces of fish muscle were removed from the oxide solutions after 5, 15, 30 and 60 minutes of immersion and transferred into sterile petri plates. These were kept for an additional hour in the cold before being placed into the incubator at 37°C. After 24 hours of incubation time all the treated samples had developed a very strong pungent odor, almost similar to that liberated from the untreated samples kept as control. The sterility tests were consequently unnecessary. Although a certain reduction of the bacterial contamination had been effected, the treatment by ethylene oxide was found absolutely useless for the purposes that we had in mind.

From these negative results it was assumed that the incomplete sterilization was due to the fact that the ethylene oxide could not reach the contamination at the inside of the fish tissue and thus eliminate all possible source of reinfection. Therefore a different procedure was devised. After the addition of ethylene oxide to the fish muscle sample under treatment, the mixture was transferred into a refrigerated Waring blendor and macerated for 30 seconds. The samples were removed from the blendor cup, transferred into sterile petri dishes, refrigerated for one hour then placed into the incubator at 37°C.

After 24 hours incubation, organoleptic and sterility tests were made on the samples. All the samples treated with 1 per cent ethylene oxide showed rapid putrefaction with the characteristic odor and appearance. Two out of the five samples treated with 2 per cent of the oxide were sterile, while at 3 per cent all were free of contamination and retained the clean odor of fresh fish. It was later noticed that when maceration of the fish muscle was incomplete, as evidenced by the presence of unbroken portions of muscle, even 3 per cent ethylene oxide did not prevent putrefaction. This observation seems to prove that, for effective sterilization with 3 per cent ethylene oxide, the fish tissue has to be well broken up so that complete contact with the disinfectant is insured. Another important factor is the original contamination of the fish muscle to be treated. It seems easier to sterilize fish muscle having low total counts because the surface bacteria have not had time to penetrate inside the muscle.

Preliminary experiments with the inoculation of pure cultures of fish bacteria on sterilized fish muscle have been initiated, but it is too early to advance definite conclusions. It is hoped that, with the present method, it will soon be possible to follow the individual action of pure cultures of bacteria on fish muscle.

H. P. Dussault

Appendix No. 6

BACTERIA OF LIGHT SALTED FISH (GASPE CURE)

I - Bacterial Variations during Pickle Salting of Fish:

Bacterial variations during the commercial preparation of light salted fish of the Gaspé Cure type, prepared by the "Kench" salting method have been reported in the 1950 Annual Report (Appendix 12). These studies were made with the purpose of determining the role played by the bacteria present during salt curing and the influence of salt penetration on the bacteria during the process. In connection with Dr. Fougère's work on the preparation of light salted fish by the "pickling" method (Appendix 4) the variations in bacterial numbers were again followed. Thus, it would be possible to compare the fate of the bacteria during both methods of salting.

To the bacteriological point of view, these two methods are basically different, although the physical phenomenon of salt penetration seems to follow the same course and, after the usual time of salting, similar concentrations are obtained. By the "Kench" salting method, the salt gradually penetrates the fish muscle while the water is driven off in the form of spent brine. This spent brine is continuously removed and never stays in contact with the fish. During this process, the bacteria that were originally present on the fresh fish are subjected to gradually increasing salt concentrations until the required one is reached. On the other hand, the salting of fish by the "pickling" method in vats is performed in a similar way as for "Kench" salting", but the spent brine is not lost as it is being formed and the fish is always in contact with it. Thus, as the salt from the brine penetrates the fish muscle, the bacteria are subjected to a brine which is gradually decreasing in strength or concentration until the optimum salt content of fish is obtained.

Variations in bacterial numbers have been followed during the salting of fish by the "pickling" method, but limited time did not allow us to repeat the experiment. Therefore the reported results must be considered only preliminary but interesting enough to justify further confirmatory work. The fish was kept during salting at 15°C. This temperature was chosen because it is approximately that prevailing during salting of fish in commercial establishments. The original count on fresh fish was made on nutrient agar and a nutrient agar with 25 per cent salt, this concentration being arbitrarily chosen for the purpose of approximating the conditions that exist when dry salt is applied to fresh fish. During the following days of salting the counts were made by plating samples of "pickle" on nutrient agar, nutrient agar to which was added a salt concentration identical to that of the pickle" and with a medium prepared by adding 1.8 per cent agar to the "pickle" itself. For the latter medium, in order to obtain a clear medium, well adapted to plate counting, the suspended fish protein first had to be precipitated by heat, then removed by filtering. Enough nutrient was left to encourage fair growth.

The results obtained with the three mentioned media are reported in the following table.

According to the results obtained the variations in bacterial numbers during the "pickle" salting of fish seem to have the same trend as those reported in previous work for "Kench" salting. The total numbers of bacteria on plain nutrient agar show a significant increase throughout the duration of the salting period. On the other hand a slight

VARIATIONS OF BACTERIAL NUMBERS DURING SALTING OF FISH AS DETERMINED ON 3 DIFFERENT MEDIA

Media / Sample	Medium without NaCl	Media with NaCl		
	Nutrient Agar	NaCl in Media	Nutrient Agar + NaCl	Nutrient Brine Agar
Fresh Fish	$3.66x10^3$/g	25%	0	--
Pickle after 1 day of salting	$9.35x10^4$/ml	17%	$5.8x10^3$/ml	$9.1x10^3$/ml
Pickle after 2 days of salting	$2.54x10^5$/ml	16.3%	$1.9x10^3$/ml	$4.2x10^3$/ml
Pickle after 3 days of salting	$1.67x10^5$/ml	15.5%	$1.48x10^3$/ml	$3.1x10^3$/ml

decrease is noticed on the two media containing NaCl. Therefore it seems that bacterial adaptation follows the same course when either salting method is used. One of the main apparent advantages of "pickle" salting is that a more uniform distribution of salt and bacteria is produced, resulting into a more uniform product. One way of determining if other differences exist will be to follow the variations of bacterial species during salting. This aspect of the problem is planned for the coming year.

II - The fate of Coliform Bacteria during preparation of Light Salted Fish:

The purpose of present work was to determine the occurrence of the coliform bacteria in fresh fish and their survival in the preparation of light salted fish, which includes the salting and drying periods.

Samples were taken during the commercial preparation of fish in a local plant.

In the evaluation of total bacterial numbers, ten grams of fish were added to 90 cc. of sterile water and macerated. Appropriate dilutions were made and after thorough agitation, platings were made in the usual manner, using plain nutrient agar and nutrient agar with NaCl, the NaCl varying according to the percent found in the fish.

VARIATIONS OF TOTAL NUMBER OF BACTERIA AND COLIFORM BACTERIA (M.P.N.) DURING COMMERCIAL SALTING OF FISH

Fish Sample	% Moisture	% Salt	Total number per gram dry weight		
			Nutrient Agar	Nutrient Agar + NaCl	M.P.N.
Fresh Fish	81.2	-	5.25×10^5	4.27×10^5	20.
Fish One Day Salted	77.2	2.8	4.95×10^5	3.0×10^5	9.1
Fish Two Days Salted	76.3	3.7	5.0 x 10	1.3 x 10	5.2
Fish Three Days Salted	75.	5.1	4.85×10^5	9.6×10^4	2.5
Washing	75.2	4.8	5.0×10^5	9.8×10^4	4.0
Cross-Piling	74.	5.5	2.9×10^5	8.0×10^4	1.3
2 days Drying	70.1	5.8	1.0×10^5	6.3×10^4	0

In the detection of the coliform bacteria, procedure was as prescribed in the "Eighth Edition of Standard Method of Water Analysis".

Three individual series were done during the summer months and the average results are shown in the accompanying table.

A very low number of coliform bacteria was found on fresh fish. Their number decreases during salting and finally disappears during drying. We can assume that salt fish is not a natural habitat for the coliform bacteria and that the salt concentration present in the finish product is sufficiently high to insure complete inhibition.

H. P. Dussault
R. A. Lachance

Appendix No. 7

IMPROVED MEDIA FOR RED HALOPHILIC BACTERIA FROM SALT FISH

For the past few years many efforts and much time has been devoted towards the development of a culture medium that would produce a more rapid and more abundant development of red halophilic bacteria. With the media advocated and utilized up till now, the cultivation of halophilic bacteria, especially the types responsible for the red discoloration of salt fish, was an inconveniently long operation lasting several days. Consequently, studies dealing with the cultural characteristics of these organisms, the evaluation of bactericidal agents and the bacteriological analysis of salt stocks, salt fish and contaminated areas was seriously hampered by these long incubation periods. The present work deals with the preparation of an improved medium that will promote a heavier growth of red halophilic bacteria in a shorter incubation time.

Preparation of Inocula: The inocula used for testing the media were prepared from an actively growing slope culture of a Micrococcus species isolated from reddened codfish. Cultural characteristics and microscopic examination have showed its similarity to Sarcina littoralis described by Poulsen and probably to Micrococcus morrhuae described by Klebahn. A heavy suspension of the culture was prepared in a 20. per cent NaCl solution, but sufficiently diluted to remove all trace of pink coloration. This constituted the heavy inoculum. A lighter inoculum was obtained from the former by further diluting one part of the heavy suspension with 100 parts of NaCl solution. The ability of the media to develop red halophilic bacteria was also tested with a brine solution made up of 30 per cent commercial salt that had previously been found contaminated with red bacteria. This last method of inoculation was found very appropriate since it is the one used in the laboratory for the bacteriological analysis of salt samples and since red bacteria present in contaminated salt have longer lag periods than actively growing cultures.

Preparation of medium: Numerous attempts have been made by us towards the final choice of a basic substance around which a more satisfactory medium would be built up. Of the many substances tried, none proved very successful or showed , any marked advantage over Lochhead's skim milk-salt agar medium. Skim milk was still the best basic material in the preparation of media for the cultivation of red halophilic bacteria since it supported fair growth and supplied a better background for the evaluation of the extent of development and shade of pigmentation. This explains why Lochhead's medium has been so widely used by recent investigators and why it was chosen in this work as the basis of the following modifications.

The proposed medium is prepared from a nutrient brine containing $MgSO_4 \cdot 7H_2O$, 5.0 g; $Mg(NO_3)_2 \cdot 6H_2O$, 1.0 g; $FeCl_2 \cdot 7H_2O$, 0.025 g; Proteose Peptone No. 3, 5.0 g; glycerol C.P., 10.0 g; and C.P. NaCl, 200.0 g (which concentration is always expressed in this paper as 20 per cent) in 1000. ml distilled water. This nutrient brine is then divided into two equal portions. To the first, 10 per cent Bacto-skim milk is added and to the second plain Bacto-agar in a 3 per cent concentration. When the agar portion is thoroughly melted and the well suspended skim milk brine lightly warmed, equal amounts of each are carefully mixed together in a flask and 15 to 20 ml quantities are transferred immediately into petri dishes with the use of a fast delivery pipette. The use of a pipette instead of pouring from the flask aids in the elimination of air bubbles produced when the skim milk and agar portions are mixed together. Slopes for the transferring of cultures are prepared in a similar way.

It has been noticed that the medium thus prepared does not have to be sterilized. During the several months the medium was utilized for routine analysis and cultural studies, uninoculated control plates were often incubated but never showed any contamination. It seems that the high NaCl concentration is sufficient to eliminate the most common contaminants. Thus the stock nutrient brine and salt agar can be kept in the cold for several weeks without alteration. However it is advisable to prepare fresh skim milk brine every time it is needed.

Attempts to buffer the medium with the ordinary salts have not yielded any improved results which led to the conclusion that this operation was unnecessary. The optimum pH of the medium was found to be 7.2-7.5. This range is well in agreement with the findings of other workers concerning the growth of halophilic bacteria in media of high NaCl concentrations.

Evaluation of media: Lochhead's codfish medium, his skim milk-salt medium and Hess' modification of Lochhead's medium C were prepared and inoculated for the purpose of comparing with the improved medium proposed in this paper. The three inocula previously described were tested. Individual drops were transferred by means of a pipette unto the surface of the agar media in petri dishes. The plates were removed each day from the incubator kept at 37°C. and carefully examined by visual observation for the time at which red growth first appeared and also for the extent of development and pigmentation. The results obtained from these comparison studies are illustrated in table 1 and figure 1.

TABLE 1

Comparison of media for the time required to evidence beginning of growth of red halophilic bacteria.

Media	Time in days at 37°C.		
	Heavy Inoculum	Light Inoculum	Contaminated Brine
Lochhead's medium B	5	6	10
Lochhead's medium C	4	5	10
Hess' modified medium	4	5	10
Improved medium	2	3	5

Figure 1 and table 1 show clearly the superiority of the proposed medium over some others that have been advocated and utilized until now. The cultivation of red halophilic bacteria becomes more rapid. With the three inocula tested, development was observed on the improved medium in half the time required by the other media. Also, it yielded a volume of growth several times heavier as evidenced by the thickness of the film and the intensity of pigmentation. These two major improvements contribute greatly to the cultural studies of halophilic bacteria by shortening the usually long and inconvenient lag period. Results of bacteriological analysis of salt samples and salt fish which are always urgently needed, can now be obtained more rapidly.

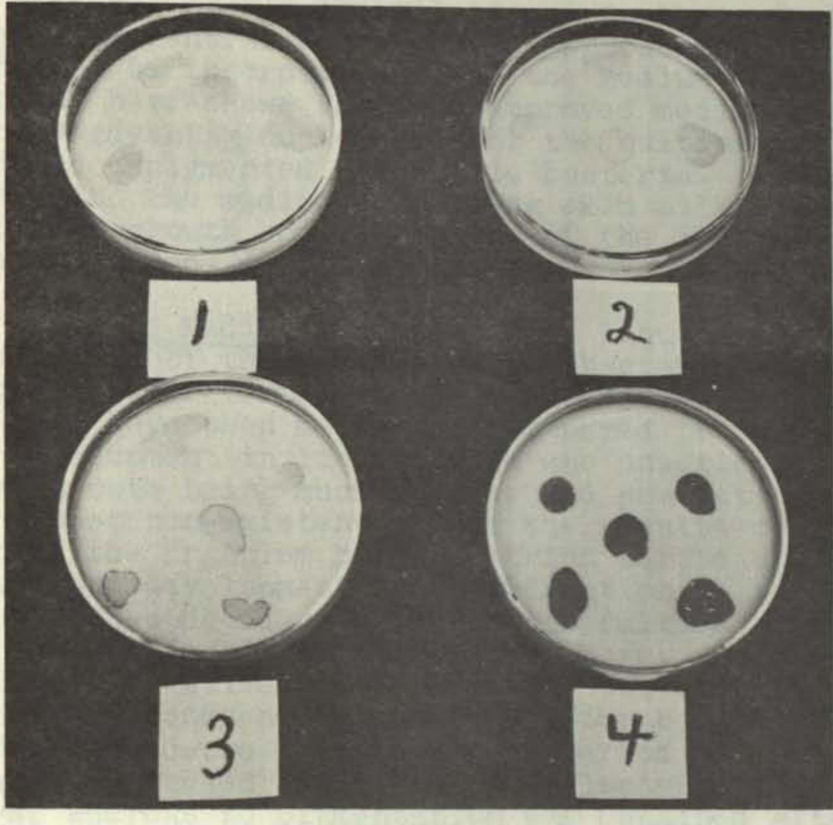


Figure 1 - Comparison of media for optimum growth of red halophilic bacteria after 6 days at 37°C.

1. Lochhead's medium C

2. Lochhead's medium B

3. Hess' modified medium

4. Improved medium

Technical improvements have been noted in the preparation of the proposed medium. With the elimination of the sterilization process, it is now possible to prepare the medium for routine analysis in salt fish plants without excessive care and costly installation. Another advantage is that higher concentrations of NaCl, approaching saturation if required, can be incorporated into the medium. Preliminary observations have shown that the improved medium without skim milk can be advantageously used for the cultivation of associated and unpigmented halophilic bacteria. In the same manner as with the medium containing skim milk, increases in the volume of growth and shortening of the incubation time have been observed.

Liquid Medium: The need of a liquid medium for the development of the red halophilic bacteria would seem very necessary for certain types of studies. Although improvements have been made, when compared to the solid medium, development in liquid media was unsatisfactory, volume of growth being much smaller and production of red pigment almost non-existent. From the results obtained it seemed that the organism being a strict aerobe could only attain optimum development and pigmentation by surface growth. It was therefore decided to aerate the culture by bubbling air through the nutrient brine described above. This was done by creating a negative pressure in the culture flasks, which were kept in a constant temperature water bath at 37°C. This system markedly decreased the growth period of the organism and greatly increased the yield. We also obtained pigmentation in 3 days, whereas no pigmentation was obtained after 15 days in the non-aerated flasks.

Aeration would therefore appear essential for the optimum growth and pigmentation of the organism.

With this method we hope to make a thorough study of the nutrition and metabolism of the red halophilic bacteria.

H. P. Dussault
R. A. Lachance

Appendix No. 8

SOME CHEMICAL CONSTITUENTS OF RED HALOPHILIC BACTERIA

Much speculation still exists concerning the mode of action of halophilic bacteria; why they tolerate such high salt concentrations and why they require them for their normal metabolism. Although numerous efforts have been made, a satisfactory explanation has not yet been reached. But since it has often been demonstrated that there exists a certain correlation between the cell constituents and the biological activities of microorganisms, a preliminary determination of the major chemical components of the red halophilic bacteria has been performed.

The chemical analyses were made on a Micrococcus species isolated from reddened codfish and whose cultural characteristics are closely similar to Sarcina littoralis described by Poulsen and to Micrococcus morrhuae described by Klebahn. Heavy cultures were grown on the improved skim-milk salt agar medium described in appendix 7 but the main difficulty consisted in the harvesting of the bacterial cells. It was impossible to wash off the culture with distilled water for fear of removing portions of the culture medium along with the culture itself and also because immediate plasmolysis of the cells would have resulted, rendering manipulation of the material almost impossible. On the other hand a brine solution could not be used because additional salt would have interfered with the analyses. The only practical way of harvesting the culture was by scraping gently a platinum loop over the surface of the medium and transferring these small quantities into beakers containing absolute alcohol. The vegetative mass was broken up with a glass rod, dried in the oven for 24 hours, then finely ground in a mortar until a light pink powder was obtained. This powder which was used in all the analyses was kept in a desiccator under vacuum.

During harvesting of the culture, the moisture content of the collected material was determined by drying given quantities in the oven, during 24 hours, at temperatures varying between 105 and 110°C. It must be kept in mind that the results for moisture content, as well as for all the other analyses, always represent the average value obtained from six different determinations or replicates. It has been found that the moisture content varied between 54 and 58 per cent of the total weight, this variation being characterized by the age of the culture and the state of desiccation of the culture medium.

Total ash was determined by incinerating portions of the dry material in the muffle furnace at 650°C. during 6 hours. During incineration, heat never rose above the dull red and a white residue was always obtained. Thus the average ash content was found to be 32 per cent.

For the purpose of explaining how the protoplasm of the red halophilic bacteria can tolerate and proliferate in the presence of such high NaCl concentrations, the determination of the NaCl content of the bacterial cell seemed most important. However, the ordinary colorimetric methods could not be applied, probably because of the difficulty of liberating the NaCl that was so intimately bound to the other cell constituents. Consequently determinations had to be made on the ash obtained in the previous analysis, by precipitating the NaCl as the silver chloride and determining it gravimetrically. The average value was 20. per cent NaCl on a dry basis or 63 per cent of total ash.

For the determination of total nitrogen in the dry material, the Micro-Kjeldahl method was used. An average value of 5.35 per cent was obtained for total nitrogen. Since a specific factor for converting total nitrogen into bacterial protein does not exist, the common factor 6.25 was used, giving 33.43 per cent cellular protein content in the red halophilic bacteria.

The alpha-amino nitrogen content was determined by the method of Pope and Stevens which is based on the formation of soluble copper compounds, the amino acids reacting with an excess of copper phosphate. Determinations were made on HCl hydrolyzates of the dry substance. An average value of 3.56 per cent alpha-amino nitrogen was obtained indicating that two thirds of the total nitrogen of the red bacterial cell is under the alpha-amino form.

The polysaccharides of the bacterial cell are an important constituent since they are accumulated by the bacteria within the cell, to be utilized when culture media become depleted of the necessary carbohydrates. These polysaccharides are very complex in structure; they contain hexosamines and often show the ability to combine with protein. We have used the method of Dagley & Dawes which they had modified for the determination of polysaccharides of Escherichia coli. This method consists in preparing acid hydrolyzates of the dry bacterial substance and then, in determining sugars by the Somogyi method. However the accuracy of the method is enhanced by the establishment of the optimum values for the four following variables: temperature and duration of the hydrolysis, concentration of acid and quantity of substrate used. The average value for polysaccharide content was found to be 14.6 per cent.

Another major and variable component of the bacterial cell is the fatty substance called bacterial lipids. The little information concerning the role of lipids in the general metabolism of bacteria is partly due to the inadequacy of extraction methods. In the present work the method proposed by Taylor for the extraction of lipids from Escherichia coli and its bacteriophage, has been used. The total lipids have been determined gravimetrically after a 4 hour extraction with a mixture of 3 parts alcohol and 1 part ether. The true lipids have been obtained by reextracting the total lipids with petroleum ether and determining gravimetrically the soluble portion after evaporation. Thus red halophilic bacteria were found to contain 3.8 per cent total lipids and 3.2 per cent true lipids.

It is almost impossible to compare the results obtained in the present analysis of the red halophilic bacteria with those reported by various investigators on other types of bacteria. Bacteria being truly distinct entities with specific functions, they must necessarily have different constitutions. In fact, the chemical composition is a function of the particular metabolism or activity of each genus or species of organism.

It is realized that the present analysis is too incomplete to allow an adequate explanation of the specific metabolism that distinguishes red halophiles from the other bacteria. Many other constituents, although present in traces, but of extreme importance, must be determined. Much work remains to be done before this objective is reached.

The special mechanism by which red halophilic bacteria can tolerate such high NaCl concentrations has not been explained. It is true that the bacterial cell contained 20 per cent salt on a dry basis when grown on a medium containing an identical concentration. But if we consider the bacteria in its normal state, i.e. on a wet basis, there is only 10 per cent NaCl inside the cell. Then, the theories of membrane permeability and osmosis do not seem to hold true. It is probable that the presence of a special mechanism confronts us with observations totally different from theoretical data.

Even when the salt content has been subtracted from total ash, the 12% per cent value obtained for residual ash seems incredibly high as compared to the ash content of any other biological material, even of bacterial origin. Time has not permitted a more complete analysis of its inorganic composition. But a more detailed study of this aspect has been planned and will certainly give interesting data concerning the mineral requirements for the nutrition of red halophilic bacteria.

H. P. Dussault

Appendix No. 9

AMINO ACIDS OF THE RED HALOPHILIC BACTERIA

The amino acid composition of bacteria is a subject that has always been of utmost interest to both biochemists and bacteriologists on account of the importance of the nitrogen metabolism in nutritional studies of bacteria. In spite of the fact that the substrate was always obtained in relatively small amounts and that the methods in use involved long and difficult techniques, important studies have been reported. However, recent advances made in the paper partition chromatography technique have helped considerably in eliminating these difficulties, because it is much more rapid, almost as accurate and allows the determination of all the amino acids in samples of the material of the order of a few milligrams.

The substrate used for the amino acid determinations is the same dry material obtained from a Micrococcus species as described in appendix 8. There is no need for explaining the paper partition chromatography technique - which is well known by anyone interested in the subject. The method of Consden, Gordon and Martin has been used along with the modification of Williams and Kirby for the ascending capillary action. The solvents used were 80 per cent phenol for the first phase and for the second, a mixture of lutidine, collidine and water in the proportion 2:2:1. A .1 per cent solution of ninhydrin in butanol was the reagent used for the development of the spots on paper chromatograms which were always made of Whatman No. 1 filter paper.

Free amino acids

Water extracts and absolute alcohol extracts of the dry bacterial matter were made and analysed for the presence of amino acids. Even when massive quantities of these extracts were placed on the paper chromatograms the complete absence of amino acids was always evidenced. From these negative results it can be concluded that, if free amino acids exist in the red bacterial cell, they must be in extremely small amounts so that they cannot be determined by the present method.

Bound amino acids

The bound amino acids of the red halophilic bacteria have been determined on acid and alkaline hydrolyzates. To 100 mg quantities of the dry matter 2 ml 6.N HCl and 2 ml 6.N NaOH have been added in small ampoules. After sealing these ampoules, they were placed in the autoclave for 6 hours at 116°C. and 12 lbs. pressure. On completion of hydrolysis, the excess HCl was evaporated off on a water bath at 50°C., in one case, and in the other, the excess NaOH was neutralized with H_2SO_4. These two hydrolyzates were then diluted to known volumes, and concentrated on a water bath to small quantities before being placed on the chromatograms. The hydrolyzates were observed to contain the following amino acids: aspartic acid, glutamic acid, glycine, alpha-alanine, valine, leucine and /or isoleucine, proline, tyrosine, serine, threonine, alpha-aminobutyric acid and methionine sulfoxide.

The amino acid composition of red halophilic bacteria seems to differ appreciably from that of other bacteria. The absence of phenylalanine, arginine, lysine, histidine and tryptophane has been particularly noticed, whereas they have been reported in the hydrolyzates of Escherichia coli and Corynebacterium diphteriae. But it must be borne in mind that these two are pathogens and consequently have more exacting requirements. On the other hand, alpha-aminobutyric acid has been found in the hydrolysates of the red halophiles whereas it was not found in the two species mentioned above. Two different precursors, glutamic acid and methionine, can be responsible for the presence of alpha-aminobutyric acid. The fact that only small quantities of methionine in the sulfoxide form have been traced might explain the presence of alpha-aminobutyric acid. Possibilities exist that some technical difficulties of the method might have prevented the appearance of tryptophane and phenylalanine and also that arginine, histidine and lysine might have been destroyed during the hydrolysis.

However, it has been realized during the present work of what help the paper partition chromatography technique can be to the bacteriologist. The simple determination of the amino acids of bacteria offers unlimited possibilities. More particularly it can help solve the varied and complex problems of bacterial nutrition. Along this line, the study of the nitrogen metabolism of the red halophilic bacteria has been attempted in this laboratory by following the changes taking place in the bacterial culture filtrates during the growth of the organism. But the high NaCl content always present in the culture media has created a major interference to the progress of the work by preventing a clear separation of the individual amino acid spots on the paper chromatograms. Desalting methods have been tried but completely satisfactory results have not yet been obtained. This problem has to be solved before studies on the metabolism of red halophilic bacteria can be resumed.

H. P. Dussault
A. Domnas

Appendix No. 10

THE GERMICIDE AGAINST RED HALOPHILIC BACTERIA

Attempts to find a disinfectant which would completely destroy the red organism were continued.

In performing test for the germicidal activity

TABLE 1

Compound	Concentration				
	1/1000	1/2000	1/3000	1/4000	1/5000
Arquad C	−	−	−	−	−
Arquad S	±	±	±	±	+
Dowicide A	±	+	+	+	+
D.H.A.S.	+	+	+	+	+
AM.-1120	−	−	−	−	−
AM.-1140	±	±	±	+	+
AM.-1160	±	±	±	+	+
AM.-1180	±	±	+	+	+
AM.-1181-5B	±	±	+	+	+
Roccal	−	−	−	±	±
Steryl	±	+	+	+	+
R2L	±	+	+	+	+
G-271	±	+	+	+	+

\+ = destroyed

± = partially destroyed

− = no destruction

of our compounds inconsistencies were noticed. In some cases high concentration of the tested compounds permitted survival and subsequent proliferation while a lower concentration seemed to have had a germicidal effect. Therefore a "filter paper" method was adapted.

Squares of "filter paper" were soaked for 5 minutes in a heavy suspension of red halophilic bacteria in brine, after which they were partially dried. These were then submerged in the disinfectant solutions being tested. After 30 minutes they were taken out and drained of their excess and plunged into a sterile brine solution and shaken. This procedure was done in order to eliminate any disinfectant that could be carried over by the "filter paper" and exert a bacteriostatic effect on the test medium. Both the filter paper and the brine were plated on skim-milk salt agar and incubated at 37°C. Table 1 shows the results obtained.

Repeated experiments with this method gave consistent results. Filter paper being porous, the bacteria readily penetrated it and remained attached to it.

The quarternary ammonium salt Arquad C and the amine salt AM.-1120 were found to destroy the red halophilic bacteria in all concentrations tested, but conditions in the laboratory being different from the industry these will have to be tested in the industry before we can say that they are effective in the destruction of the red organism.

R. A. Lachance

Appendix No. 11

EFFECT OF CHEMICAL DISINFECTANTS ON "SPORENDONEMA EPIZOUM"

As a result of disinfection with a brilliant green solution, a marked reduction of contamination by Sporendonema epizoum, commonly called "dun", had been reported last year (appendix No. 16). Although these results were fairly satisfactory, attempts to discover more effective disinfectants have not ceased. A new series of chemical compounds, all of them recommended as highly effective, have been tried in the laboratory by a different testing method.

The main feature of the technique consists in removing after the treatment all traces of the disinfectant before transferring the test organism into culture media for survival tests. This would eliminate the possibility of a fungistatic effect occasioned by the presence of small amounts of the disinfecting substance in the culture media. Thus, a heavy mass of Sporendonema epizoum spores is placed into a centrifuge tube and the disinfectant added in given concentrations. After a certain period of contact time during which occasional shaking is done, the suspension is centrifuged and the spent disinfectant discarded. Sterile 15 per cent brine is then added to the spore mass, the tube is well shaken up and centrifuged again. This washing is done twice after which the spores are inoculated unto the media for sterility tests.

In the present work, the "dun" spores were contaminated by the presence of a Penicellium and an Aspergillus species, these contaminants being often found along with Sporendonema epizoum in light salted fish. The contact time between the test organisms and the disinfectants was 30 minutes and Schoop medium was used for survival tests. After only four days, the control plates of untreated test organism showed heavy development. All the other plates were kept for at least two weeks. The accompanying table lists the different chemical substances tried, the dilutions prepared and the results obtained.

Substance \ Dilution	1:1000	1:5000	1:10000
Arquad C	+	+	+
Arquad S	+	+	+
AM.-1120	-	-	± *
Dowicide A	+	+	+
Steryl	+	+	+
R2L	+	+	+
G-271	+	+	+

\+ = Survival of test organism, - = Destruction

* = Survival of "Dun" and disappearance of Pen. and Asper.

The results indicate that the mold Sporendonema epizoum along with the accompanying types of Penicillium and Aspergillus is a highly resistant contaminant. This is shown more particularly when such high concentrations as 1 part in a thousand of the usually effective disinfectants tried have absolutely no effect. However, AM.-1120 in a concentration 1:5000 has proved to be totally effective against the three molds treated although a 1:10,000 concentration had no effect on the Sporendonema epizoum. Plans are made for the use of AM.-1120 in the disinfection of contaminated fish plants as soon as the next fishing season is ready to get under way.

H. P. Dussault

S E C T I O N   II

DRYING

Appendix No. 13

EFFICIENCY OF AN ARTIFICIAL DRYER

In appendix No. 18 of last year's Annual Report a description of the modifications and addition of new equipment for the modernization of an old artificial dryer was presented. The installation was not completed in time to permit experimental tests to find out the general efficiency of the plant, but the dryer was in operation for all the fishing season this year and it was possible to verify the temperature, relative humidity, velocity of air, time of drying, appearance of product obtained etc.

This large dryer has a capacity of about 40,000 pounds of green salted codfish which is about nine times the capacity of the unit used for our experiments and it was used for Gaspé Cure in part of the drying process when atmospheric conditions or space requirements did not permit natural drying outside on flakes. The dryer seems adequate for the production of Gaspé Cure and good drying rates were obtained. From the dried product, it may be said that drying is uniform in all parts of the dryer. The capacity of the supply fan is sufficient to give adequate relative humidities in the dryer when atmospheric conditions are not too bad and the steam heater with temperature regulator is able to maintain the temperature in the required limits. The amount of supply air is not as considerable as with the unit we used for our experiments and for this reason the dryer is not so efficient when atmospheric conditions are not good. However bad atmospheric conditions were encountered for only four or five days in August and good drying rates were obtained for the major part of the fishing season. The air velocity is uniform for all the sections in the dryer and is more than twice as great as that used for our experiments. However, this considerable air velocity is not prejudicial with such a dryer of large cross-section and is helpful for the maintenance of similar conditions in all parts of the dryer. The only thing missing for the perfect operation of this dryer is a means to control the relative humidity. As it is, the same quantity of fresh air is always entering the dryer and this may be unnecessary when the drying rate is low such as at the end of drying or when atmospheric conditions are favorable. In the fall, the relative humidity may be very low in the dryer and the heat requirements unnecessarily high if the air supply is not controlled. The best way to regulate the admission of fresh air seems to install a damper with a by-pass between the inlet and outlet duct. With this arrangement, when the relative humidity is sufficiently low in the dryer, the supply fan takes the air from the dryer by the outlet duct and there is recirculation. When the relative humidity is high, the damper changes the admission to the supply fan which takes fresh air from outside. With these kinds of dryer, it is not a good way to control the relative humidity by stopping the supply fan because the motor may be damaged by frequent startings and stoppings and also because the steam heater is located outside the dryer and when the fan is stopped, there is no heat supplied to the dryer.

The efficiency of the dryer is far superior to that obtained previously before the modifications and the owners seem to be satisfied with the results obtained this year.

R. Legendre

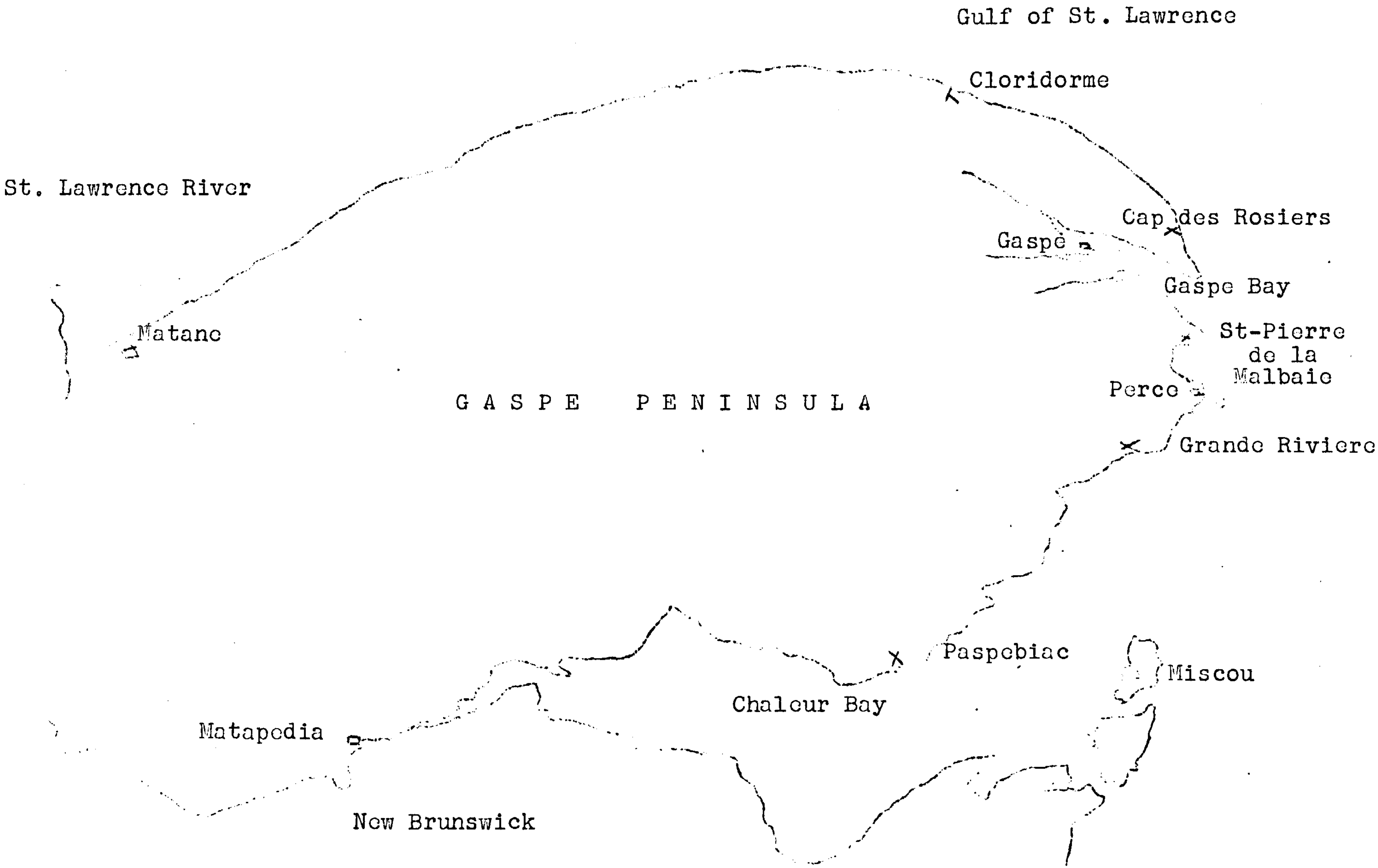
Appendix No. 14

ATMOSPHERIC CONDITIONS AND DRYING

For the last five years, daily recordings of temperature and relative humidity have been made in Grand River at ground level and at fifty feet above the ground. The readings have shown that there is no advantage in taking the air at fifty feet above ground as in certain cases the dew point is even lower at ground level. It was also shown that atmospheric conditions are generally suitable for artificial drying of codfish during a good part of the summer and that drying operations could often be carried out at night when conditions did not permit drying in day time.

This year, recordings were made at ground level only but it was decided to obtain recordings of temperature and relative humidity from different points on the Gaspé Peninsula as shown in figure 1. The fishing centers chosen to install the wet and dry bulb recorders were the following: Cloridorme, Cap-des-Rosiers, Malbaie, Grand River and Paspebiac. These readings were made in order to find out if there are appreciable changes in atmospheric conditions for different parts of the Gaspé Coast and study the application of various drying methods for the production of dried salted codfish.

With artificial drying it would be possible to be absolutely independent of atmospheric conditions by the use of a dishumidifying equipment in connection with the dryer. However this equipment is expensive and in general is not used in the production of codfish. The conditions to be maintained in the dryer are a temperature of 80°F. and a



(X--Places where recorders were located) relative humidity of 50 to 55%. To obtain these conditions, it is necessary that the outside temperature is below 80°F. and that the dew point is below 55°F. No difficulty is encountered with the temperature on the Gaspé Coast because it is usually below the limit. However the dew point is often above 55°F. during the summer months. With dew points between 55°F. and 65°F., artificial drying is possible but the relative humidity in the dryer will be high and drying time may be much longer particularly with dew points between 60°F. and 65°F. With dew points above 65°F. it will be impossible to obtain in the dryer a relative humidity sufficiently low to permit a profitable operation and it may be stated that drying is impossible with dew points above 65°F.

With natural drying outside on flakes several factors are encountered and it is difficult to specify definite atmospheric conditions for the possibility of the operation. A slight breeze of wind is essential and sun rays are very important. The relative humidity of the air may be good for drying but if there is no wind the operation will be very slow even with sun rays. On the other hand, it is possible that relatively good drying rate is obtained with unsuitable atmospheric conditions when sun rays are heating the surrounding air and wind is present. Wet and dry bulb recordings are atmospheric conditions taken in the shade, but when sun rays are present, the air surrounding the fish is heated and the relative humidity is lowered. As a general rule, it may be said that natural drying outside is possible when the relative humidity of the air surrounding the fish is lower than 70%-75% and a small breeze of wind is present.

The results obtained from the recordings are shown in tables 1 and 2. Table 1 shows for each week the mean temperature, relative humidity and dew point obtained from the recordings in Cloridorme, Cap-des-Rosiers, Malbaie, Grand River and Paspebiac. Table 2 shows, for the same places, the mean atmospheric conditions during July, August and September. The table gives also the percent of days and those of nights during which the mean dew point was between 55°F. and 65°F. for the same months. In Cloridorme and Cap-des-Rosiers, the recorders were not obtained in time to get results for July, thus the figures are for August and September. From the tables it is shown that the most suitable atmospheric conditions for drying are encountered in Cloridorme and the worst in Grand River. Not one day was found with dew point above 65°F. and it means that artificial drying would have been possible every day during the summer for each of the places where recordings were taken. However the conditions were not always favorable for the use of the best relative humidities in the dryer and in Grand River, for example, the dew point was between 55°F. and 65°F.

Table 1

Week Number		Cloridorme			Cap desRosiers			Malbaie			Grand River			Paspebiac		
		D.B.	R.H.	D.P.	D.B.	R.H.	D.P.	D.B.	R.H.	D.P.	D.B.	R.H.	D.P.	D.B.	R.H.	D.P.
July	2°										64.2	86.9	58.4	65.5	78.1	58.1
	3°							59.3	83.9	54.0	60.3	84.6	55.2	63.4	75.9	55.3
	4°				60.8	68.7	50.8	60.6	77.4	52.6	60.2	85.0	56.6	60.8	68.3	49.9
August	1°				59.5	74.5	52.4	57.2	81.4	53.1	58.5	89.4	55.3	64.0	73.9	55.1
	2°	60.2	72.2	50.6	58.0	75.5	52.0	58.0	80.5	53.0	58.8	90.0	55.3			
	3°	57.7	69.4	48.2	56.5	79.5	50.3	56.8	89.1	53.4	61.6	87.0	57.7	59.4	77.5	51.9
	4°	59.2	79.7	52.8	58.7	85.7	54.7	59.3	92.2	56.7	57.7	90.5	54.8	63.0	84.5	58.1
	5°	59.8	74.0	51.4	52.3	64.6	48.2	59.7	85.2	55.4	62.7	84.9	61.6	59.7	78.3	52.9
September	1°	56.3	66.2	45.1	54.0	74.9	42.5	53.4	87.0	49.3	59.0	94.0	57.1	55.9	77.0	47.6
	2°	58.7	76.0	50.8	57.7	84.0	52.6	58.3	93.0	55.9	57.7	94.1	55.9	61.6	85.0	56.7
	3°	58.1	68.0	47.6	54.5	74.7	46.4	55.4	88.5	51.8	54.7	87.0	51.4	56.9	75.2	49.5
	4°	50.2	67.3	40.7	48.8	74.0	40.8	48.2	88.3	44.6	48.2	93.0	45.9	50.3	79.5	41.9
October	1°	43.4	73.3	38.0	43.2	79.0	38.1	43.4	90.5	41.1	42.4	97.0	41.7	40.4	70.8	35.6
	2°	40.2	71.2	31.4	40.6	66.3	30.7	38.6	88.0	35.2	37.9	93.8	36.3	48.8	74.9	35.1
	3°	48.8	67.0	39.3				44.6	93.7	42.4	43.1	96.2	42.1	47.2	78.9	40.5
	4°							41.3	98.7	40.2	40.2	87.0	38.9	45.4	80.1	39.5
	5°							33.8	93.2	33.6	36.4	90.5	34.8	37.8	82.4	32.9

Table 2

	Cloridorme	Cap des Rosiers	Malbaie	Grand River	Paspebiac
Mean D.B.	57.5	56.1	56.9	58.5	60.1
Mean R.H.	71.6	75.6	84.1	88.8	77.5
Mean D.P.	48.6	49.1	52.6	55.4	52.4
% Days with D.P. 55-65°F.	12.5	32.8	46.0	65.0	46.6
% Nights with D.P. 55-65°F.	7.1	15.6	32.4	60.0	39.2
% Days with D.P. below 55°F.	87.5	67.2	54.0	35.0	53.4
% Nights with D.P. below 55°F.	92.9	84.4	67.6	40.0	60.8

The abbreviations have the following signification:

D.B. = Dry bulb temperature = Temperature of the air in °F.

R.H. = Percent relative humidity of the air

D.P. = Dew point of the air °F. = The temperature at which the air becomes saturated with water vapor during 65% of the days and 60% of the nights. In Cloridorme, the dew point was between the same limits during only 12.5% of the days and 7% of the nights. The results show also that atmospheric conditions are more favorable to artificial drying during night time as compared to day time.

In the case of natural drying outside, the atmospheric conditions were certainly not always good for drying but, as stated before, it is impossible to establish from the atmospheric conditions only, the number of days during which the operation was possible. However, since the relative humidity is lower in Cloridorme, it means that conditions are more suitable to natural drying in that place. This may explain also why better results are generally obtained in Cloridorme for the natural drying of "Gaspé Cure" fish. With natural drying, the action of sun rays is very useful and better results are obtained in day time.

R. Legendre

Appendix No. 15

THE ARTIFICIAL DRYING OF LIGHT SALTED CODFISH

Experiments in Grand River

The work on artificial drying of light salted codfish was carried on again this year and the experiments on the determination of the best drying conditions were completed. Several experiments were undertaken in order to find out a drying method which would give a product of the best possible quality. Finally, a few experiments were made to find the best conditions for the press-piling operation between the drying periods.

1) DRYING CONDITIONS:

a) Temperature: In last year experiments, temperatures of 85°F., 80°F. and 75°F. were studied and it was found that the best product was obtained with temperatures of 80°F. and 75°F. This year, to complete this investigation on the choice of the best temperature for the artificial drying of light salted fish, experiments were made at 70°F., 65°F. and also at 80°F. to compare with the results obtained last year. These experiments have shown that from 80°F. and lower, the temperature seems to have no influence upon the final appearance of the product. Drying is possible without cooking the fish at 85°F. but the final product is not so nice. The alteration is encountered during the last drying period.

The influence of temperature upon drying rate is shown by table 1. The table shows the results obtained at various temperatures from 65°F. to 85°F. and constant relative humidity of 55% and air velocity of about 400 feet per minute. From the table, it can be seen that the amount of water removed (dry basis), that is pounds of water removed per 100 pounds of dry material, increases with an increase in temperature. However, the main influence of

TABLE 1

The effect of temperature at a relative humidity of 55% and an air velocity of 400 feet per minute

Air Temperature °F.	Water removed (dry basis) after drying time of			
	5 hr.	10 hr.	20 hr.	30 hr.
85	34	76	111	136
80	32	62	108	132
75	40	68	112	125
70	36	60	95	113
65	34	55	78	101

temperature in artificial drying of codfish is upon the quantity of air required to dry the fish. From a psychrometric chart, it can be seen that the relative humidity decreases with an increase in temperature and that the amount of moisture that may be carried by a pound of air increases very rapidly with an increase in temperature. This is very important and shows that the artificial drying should be made at the highest temperature than can be used without injuring the material. From the experiment, this temperature was found to be 80°F. Usually, the relative humidity is maintained by varying the amount of fresh air admitted in the dryer. Therefore, if the temperature maintained in the dryer is high, the amount of fresh air necessary will be lower and the size of the blower fan will be smaller. Moreover, the amount of heat required will also be smaller because, even though the temperature in the dryer is higher, the amount of air to be heated from the outside temperature to the inside temperature will be smaller and this may become important when the outside temperature is low in the fall and winter.

b) <u>Relative Humidity</u>: From the results obtained last year, it was shown that the relative humidity has an influence upon the rate of drying only during the first period. In the second and third periods of drying, the rate is about the same for all relative humidities. It was also shown that better results for the final appearance of the fish were obtained when the last drying periods were made at relative humidities of 55% and higher. These results were obtained with relative humidities of 50%, 55% and 60%. This year, experiments were made with relative humidity of 65% and also 55% to compare with the results obtained last year. These experiments have shown that the drying rate is much slower with a relative humidity of 65% and the final appearance of the fish is about identical with that obtained when a relative humidity of 55% is used. Table 2 shows the influence of relative humidity upon drying rate during the first period for a temperature of 80°F. and an air velocity of about 400 feet per minute. It is evident from the table that the drying rate decreases with an increase in relative humidity during the first period of drying.

TABLE 2

The effect of relative humidity at a temperature of 80°F. and an air velocity of 400 feet per minute

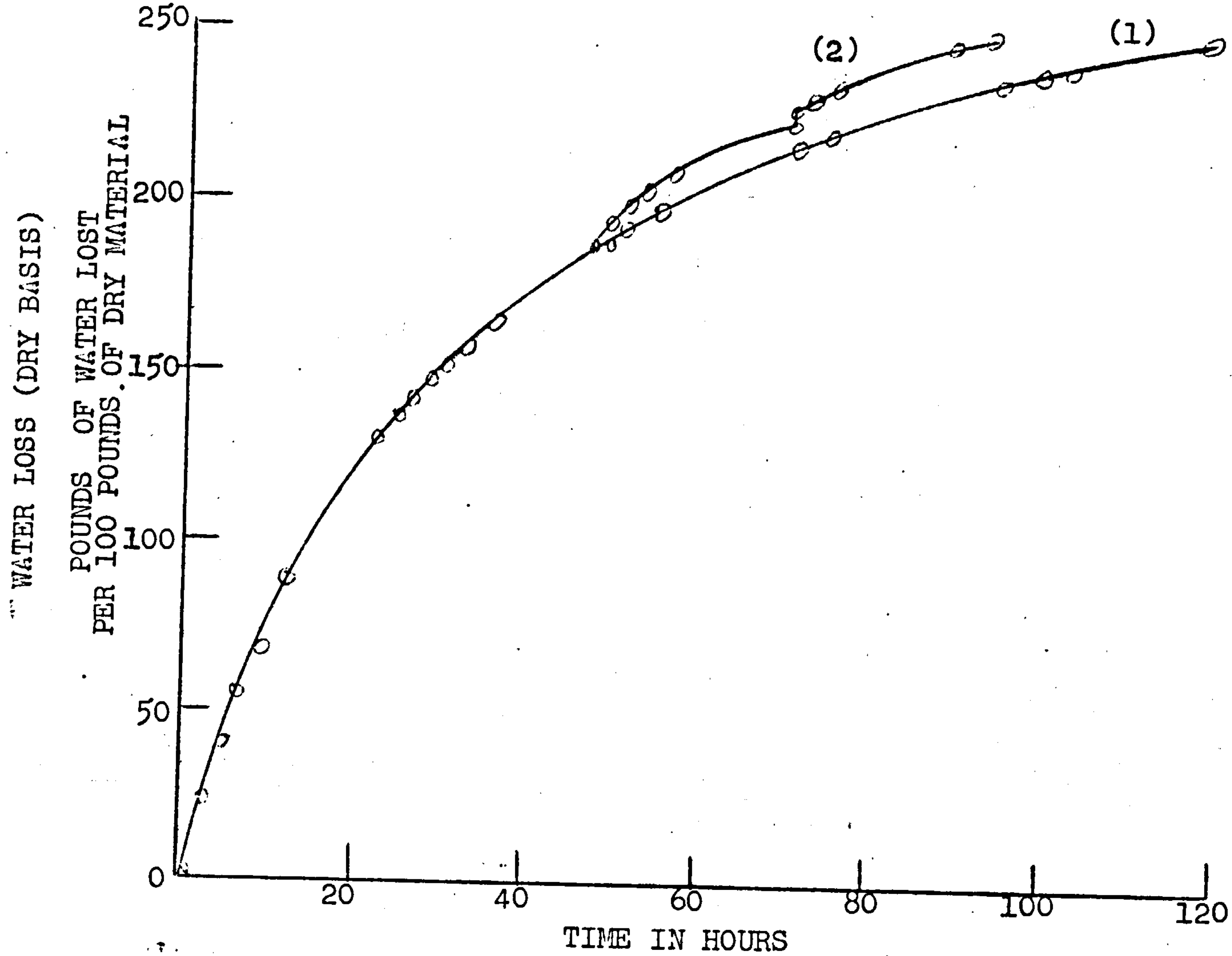
Relative Humidity %	Water removed (dry basis) after drying time of			
	5 hr.	10 hr.	20 hr.	30 hr.
65	24	46	80	108
60	28	53	93	117
55	32	62	108	132
50	43	73	111	142

In artificial drying of light salted codfish, the influence of relative humidity may be summed up as follows:

1) The best drying rates are obtained at low relative humidities but the quality of the final product is not so good with relative humidities lower than 55%.

2) The relative humidity has an influence upon drying rate only during the first period and the alteration in the quality of the product due to relative humidity is encountered only during the last period of drying.

FIGURE -1-



250
200
150
100
50
0
20
40
60
80
100
120
(1)
(2)
WATER LOSS (DRY BASIS)
POUNDS OF WATER LOST
PER 100 POUNDS OF DRY MATERIAL
TIME IN HOURS

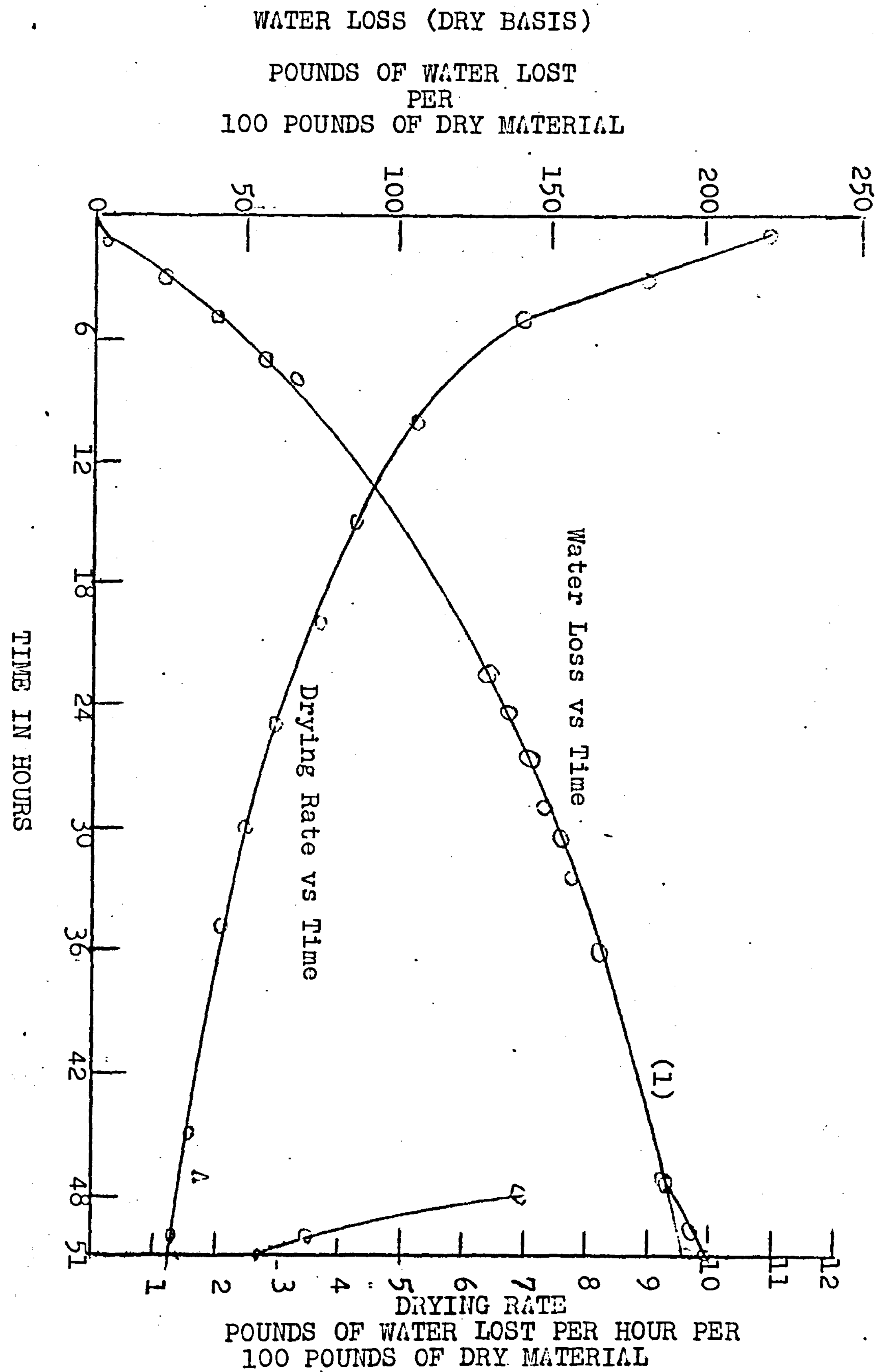

WATER LOSS (DRY BASIS)
POUNDS OF WATER LOST PER 100 POUNDS OF DRY MATERIAL
0
50
100
150
200
250
Water Loss vs Time
Drying Rate vs Time
(1)
TIME IN HOURS
6
12
18
24
30
36
42
48
51
1
2
3
4
5
6
7
8
9
10
11
12
DRYING RATE
POUNDS OF WATER LOST PER HOUR PER 100 POUNDS OF DRY MATERIAL

FIGURE -2-

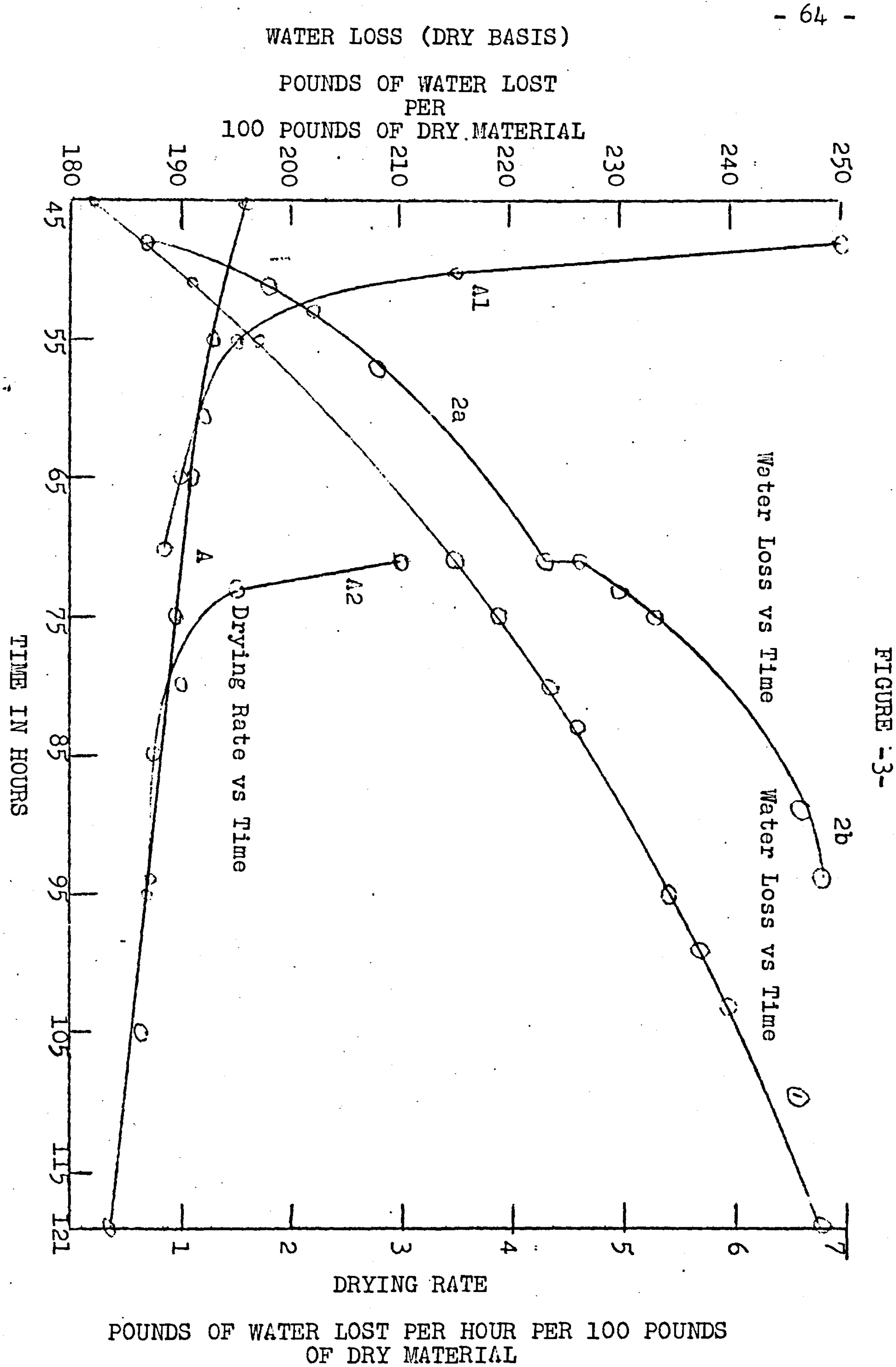


FIGURE -3-
WATER LOSS (DRY BASIS)
POUNDS OF WATER LOST
PER
100 POUNDS OF DRY MATERIAL
180
190
200
210
220
230
240
250
45
55
65
75
85
95
105
115
121
TIME IN HOURS
1
2
3
4
5
6
7
DRYING RATE
POUNDS OF WATER LOST PER HOUR PER 100 POUNDS
OF DRY MATERIAL
Water Loss vs Time
Water Loss vs Time
Drying Rate vs Time
A1
A2
A
2a
2b

From this, it is easy to see that good results should be obtained for drying rates and also for the quality of the final product, if the first period is made at a low relative humidity and the second and third period at a higher relative humidity. Then, to complete this investigation, experiments were made by using a temperature of 80°F. and a relative humidity of 50% for the first period of drying and the second and third periods were made at the same temperature but at a relative humidity of 60%. Best results were obtained by using these conditions which are recommended for light salted codfish.

c) Drying periods: With light salted codfish, continuous drying without press-piling is not possible if good quality product is to be obtained. In figure 1 the variations of the water loss with time obtained with a temperature of 80°F. and a relative humidity of 50% are shown. All water losses are in dry basis and are for 100 pounds of dry material. Curve (1) represents the water loss when light salted fish is dried continuously and curve (2) shows the results obtained when the same fish is dried in three periods and two press-pilings. From these two curves it can be seen that the drying time is much longer when the operation is made continuously and it is shown that the fish must stay in the dryer 25 hours more to remove the same quantity of water. In figure 2, the results obtained for the first part of these two methods of operation are shown. Curve (1) shows the water loss for the first 50 hours of drying and curve A shows the variations of the drying rate with time for the same period. This curve is obtained from a graphical differentiation of curve (1) and is the slope of this curve at the given time. The drying rate is expressed as pounds of water lost per hour per 100 pounds of dry material. Figure 3 shows the results obtained for the last part of drying. Curve (1) is the water loss when the operation is made continuously and curve (2) is the water loss obtained when three periods of drying are used. Curve (2)a is the water loss for the second period of drying and curve (2)b is the water loss for the third period. The curve A shows the drying rate obtained when the operation is continuous, the curve A1 shows the drying rate during the second period and the curve A2 shows the drying rate for the third period.

From figure 3 it can be seen that the drying rate decreases continuously when the drying operation is made continuously. However, when three periods of drying are used and two press-pilings, there is an appreciable increase in the rate at the beginning of each period. This is well illustrated by curves A1 and A2 and shows why drying time is reduced when the operation is made in several periods. This increase in drying rate may be explained by the internal diffusion of water from the inside to the surface during press-piling. This water is easily removed from the surface at the beginning of the drying period and the rate is increased.

However, the main purpose of drying light salted codfish in several periods is to improve the quality of the product. When the operation is made continuously the surface dries much more rapidly than the inside and there is formation of cracks which may damage seriously the product. A study of the rate curves shows that, after a certain time, drying becomes very slow and the drying rate is controlled by the diffusion rate of water from the inside to the surface. This diffusion is inversely proportional to the thickness of fish. It is independent of relative humidity and velocity of air and varies with temperature. If drying is made in periods, the internal diffusion will continue during press-piling and water will come to the surface during this operation.

The length of the drying periods have also an influence upon the quality and it is important that the first drying period is not too long. Several experiments were made to find out a good method of operation and best results were obtained when the first drying period decreased the water content of fish to about 55% wet basis and 122% dry basis. With a temperature of 80°F. and a relative humidity of 50%, the first period should be from 40 to 48 hours with medium size codfish depending of the initial water content. A second period of about 24 hours will be sufficient to decrease the water content to about 49% wet basis and 96% dry basis. For the last two periods the relative humidity is increased to about 60% as stated before. Finally, another period of 24 hours will complete the drying operation.

2) <u>Press-Piling</u>:

As stated before, the purpose of press-piling is to equalize the water distribution inside and at the surface of the fish by increasing the rate of internal diffusion and lowering the drying at the surface. The rate of diffusion may be increased by pressure and temperature, and the surface drying is decreased by an increase of relative humidity and a diminution of the air current. A few experiments were made to find out the best conditions for this operation and for this purpose an insulated room was constructed in order to be able to regulate the temperature and relative humidity.

a) <u>Relative humidity</u>: As stated before, the relative humidity should be high enough to decrease the surface drying. However, it is very important that the humidity is not so high that condensation may occur on the fish surface.

This condensation was encountered with relative humidities of 70% and higher. Best results are obtained with relative humidities in the neighborhood of 65%.

b) Temperature: The rate of internal diffusion varies with temperature, but the most important thing is that the fish must keep his quality. For that reason, as the relative humidity is high, temperatures higher than 65°F. are not recommended. From the experiments, good results are obtained with temperatures between 55°F. and 65°F.

c) Time of press-piling: The time of press-piling depends on internal diffusion and in general it can be stated that this operation has been sufficiently long when the fish surface has become slightly wetted. As stated before, the internal diffusion is favoured by the pressure of piled fish and in order that this diffusion is equal for all the quantity, it is necessary that the fish be cross-piled during this operation. Another effect of cross-piling which is very important is that it gives an even distribution of salt on the fish surface and improves greatly the final appearance of the product. From the experiments, it was found that a press-piling of 24 hours with a cross-piling is sufficient between the first and second period of drying. For the second press-piling, the internal diffusion is much slower because the fish is dryer and the piling time will be of 7 to 10 days with a cross-piling every day. The second press-piling is very important for the final appearance of this product. It is necessary that the moisture carrying salt reach the surface and a white layer will be formed on the fish surface at the end of drying.

d) Effect of pressure during press-piling: When large quantities of fish are involved as it is the case for the industry, the fish is submitted to adequate pressures during the press-piling operation. However, for our experiments, the quantity of fish used was much smaller and it was found that the operation was not so efficient. For this reason, it was decided to construct a small press. Very few experiments were made with this press but some improvements were found from its use. Pressures in the order of 500 to 800 pounds were used.

3) Conclusions:

From the results obtained by the experiments, the best conditions to be used for the various operations in the artificial drying of light salted codfish are shown in table 3.

TABLE 3

	Temperature °F.	Rel. Hum. %	Time Hours	Water content Wet basis at the end	Remarks
1° Period	80	50	40-48	55	
1° Press-piling	55-65	65	24		One cross piling
2° Period	80	60	24	48-50	
2° Press-piling	55-65	65	7-10 days		Cross-piling every day
3° Period	80	60	24	37-39	

To complete this investigation, we intend to make other experiments in order to find out if it is still possible to improve the drying method and get better results. A study of the best storing conditions for the preservation of the dried product will be carried out.

R. Legendre
H. Dupuis

Appendix No. 16

ARTIFICIAL DRYING OF LIGHT SALTED CODFISH ON PILOT PLANT SCALE

Experiments in Paspebiac

In order to verify if the results obtained at the Station on the artificial drying of light salted codfish could be identical to those obtained when the same process is applied to the industrial production, it was decided to carry on some experiments in Paspebiac where is located one of the main drying plants of the Gaspé Coast. This drying plant consists of four units of the Halifax type and one much larger unit which was modified last year as reported in appendix No. 18 of 1950 Annual Report. Arrangements were taken with the Company to carry on the experiments with one of the Halifax type units. A few modifications were necessary to adapt the dryer for light salted codfish and auxiliary controls were added to maintain more easily the proper conditions in the dryer. An insulated room was constructed for the press-piling operation between the drying periods. The installation was completed for the beginning of the fishing season and experiments were carried on during July, August and September.

MODIFICATIONS TO THE DRYER AND ADDITION OF AUXILIARY EQUIPMENT

With light salted codfish, the drying rate is much higher than with heavy salted codfish. By drying rate, we mean the amount of water per hour removed from the fish during the drying operation. Consequently, much more air will be necessary to carry away this additional quantity of water vapour and for our experiments, the supply fan of a capacity of about 2500 cubic feet per minute was replaced by a new one with a capacity of 7000 cubic feet of air per minute. Moreover, it was also necessary to change the steam heater coil because much more heat is necessary to heat the additional quantity of air entering the dryer and to evaporate the greater amount of water from the fish.

For the control of temperature, it was decided to use a motorized valve at the inlet of the steam heater instead of the system of dampers which are usually employed with these dryers. The opening of the modutrol valve is regulated by the temperature controller and if the temperature is high enough in the dryer, the valve is closed and no more steam is flowing in the heater. With the old system, the steam was always running and the air supply was by-passed when temperature was high enough in the dryer.

The unit used for drying experiments was not equipped with a means to control the relative humidity in the dryer. The hair hygrometers commonly used for that purpose do not give satisfactory results with salt fish and it was decided to use the Aminco Dunmore electric hygrometer controller. This electric hygrometer is very sensitive and the control of humidity, effected by stopping the supply fan when the relative humidity in the dryer is low, seems quite good. A wet and dry bulb recorder was also installed to take the records of temperature and relative humidity in the dryer.

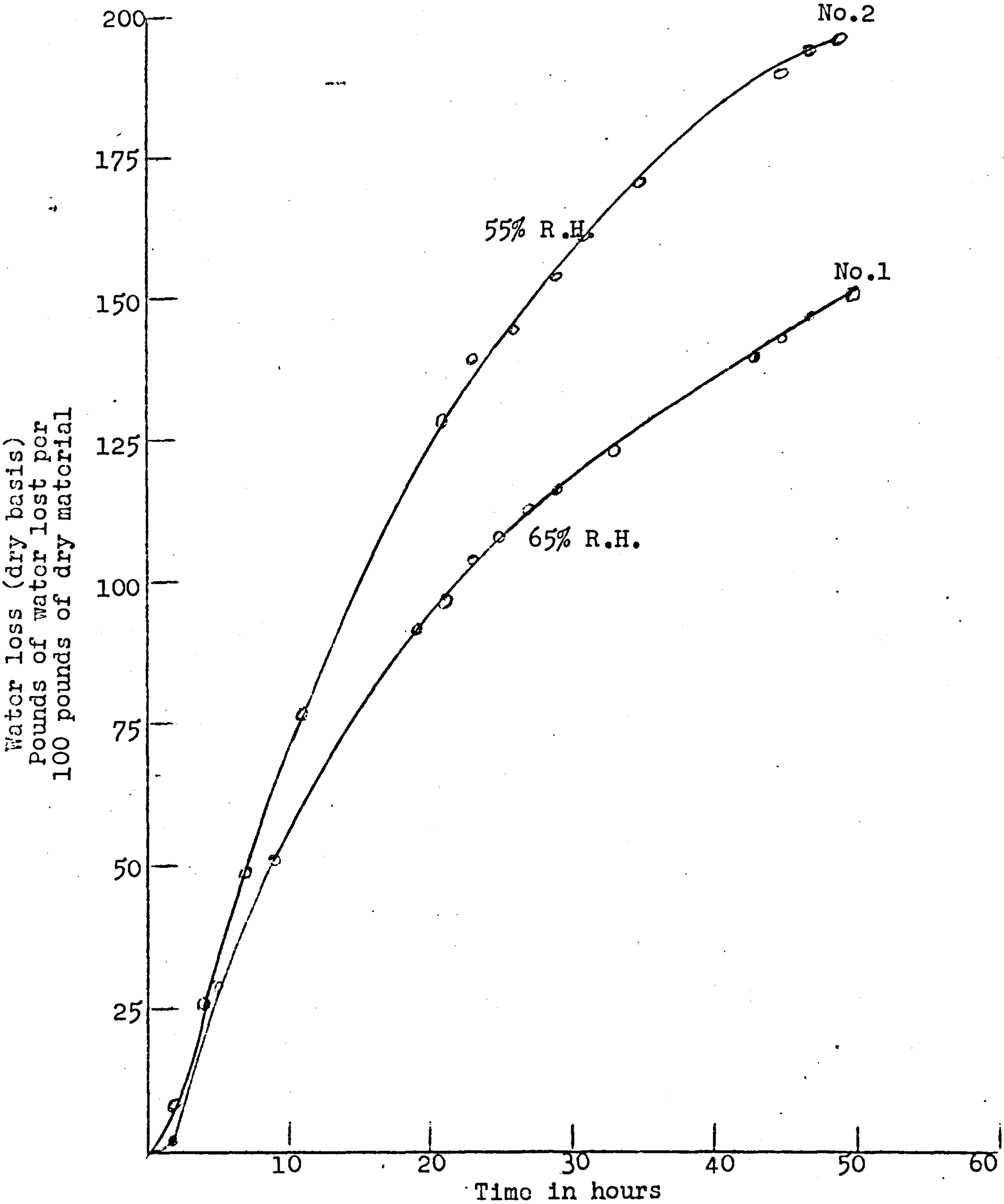
For the press-piling operation, an insulated room was constructed and a small Freon cooling unit was used to keep the room at the desired temperature during the operation. The fish was kept there between the drying periods at a temperature of 55°F.

Experiments: About 4000 pounds of salted fish were used for each experiment but the fish was not always in a good condition. From the arrangements made, the Company was supposed to furnish the fish from Paspebiac for the experiments and the salting operation was supposed to be made in a chill room by men of the Company and according to the results obtained from Dr. Fougère's experiments. However, the fishing season was not good this year in Paspebiac and it was impossible to obtain fresh fish from there. In all the cases, the fish was carried in trucks either before or after the salting operation from other fishing parts of the Gaspé Coast. With these conditions, it is impossible to obtain fish of the best quality. For the salting operation, the right amounts of salt were used for each batch but salting was not always uniform and in many cases a part of the fish contained too much salt and consequently the other part did not have enough. Before each experiment, samples were removed for determination of water and salt content. During the drying operation, weighings were made periodically to keep a record of the gradual loss in weight of the fish and the whole batch was weighed before and after each period of drying. The experiments were made by using three or four periods of drying as required. During the last periods of drying, the rate depends on the thickness of fish and the diffusion and for that reason, small fish dries more rapidly than larger fish. These experiments were based on the results obtained in Grand River from the experiments on light salted codfish and in general the same procedure was followed and identical conditions were maintained in the dryer.

Four complete experiments were made at a temperature of 80°F. and, when possible, a relative humidity of 55%. The dryer is not equipped with dehumidifying equipment and, for two experiments, it was impossible to maintain in the dryer the desired relative humidity because of external atmospheric conditions. These experiments were carried on at a relative humidity of 65% and, although the drying rate was lower, good product was obtained, showing that artificial drying of light salted codfish is possible even during warm summer days.

Figure 1 shows the drying rate curves obtained with experiments in Paspebiac. The curve (2) was obtained with a temperature of 80°F. and 55% relative humidity. This curve is for the second experiment and an identical curve was obtained at the same conditions with the fourth experiment. The curve (1) was obtained with a temperature of 80°F. and a relative humidity of 65%. This curve is for the first and third experiments. It is interesting to note from these curves that, for the same conditions, the drying rate obtained in Paspebiac was nearly equal to that obtained from the experiments in Grand River.

FIGURE I



No.2
55% R.H.
No.1
65% R.H.
200
175
150
125
100
75
50
25
Water loss (dry basis)
Pounds of water lost per
100 pounds of dry material
10
20
30
40
50
60
Time in hours

For the first experiment, two periods of drying were made artificially and the drying operation was completed outside. In the second experiment, only the first period was made artificially and drying was completed outside in the usual manner. From these experiments, it was evident that the salting operation was not quite perfect and it was decided to obtain some salted fish from Cloridorme, on the North Shore of the Gaspé Coast, where they produce regularly first quality Gaspé Cure.

Then, for the third experiment, part of the fish used had been salted in Cloridorme and carried to Paspebiac in an insulated box, and the other part was salted in Paspebiac. The whole drying operation was made artificially. The best results were obtained with this experiment and a definite improvement was found with the fish salted in Cloridorme.

The fourth experiment was made with fish from Newport. The salting operation was made in Newport and the salted fish was carried in truck from Newport to Paspebiac for the drying experiment. The first two drying periods were made in the dryer and then half of the fish was finished outside and the other half was completed artificially. The results showed that there was no noticeable difference between the fish which was finished outside and the other part which was dried all artificially. With this experiment, the quality of the final product was not so good as with the previous one and this result may be explained by the fact that contamination occurred before the drying experiment. This contamination was quite evident right at the beginning of the drying operation and was completely stopped by drying. However the damage was done and the final appearance of the product was not so good.

Considering the fact that it was impossible to obtain fresh fish and the salting operation was not always perfect, good results were obtained with these experiments and in general the quality of the fish produced was equal to that obtained at the same plant when all the drying process was made outside. However, it is still possible to improve the quality of the final product by a better preparation of the fish before the drying process. This fact was confirmed by the third experiment in which we used some fish from Cloridorme and obtained a product of the best quality.

The total cost of the production of light salted codfish including cost of fresh fish, preparation, salting, drying, labour, fuel and power should amount, from a preliminary estimate, to about $15.00 per 100 pounds of dried product. The cost of the drying operation alone is estimated at about $3.00 per 100 pounds of dried product.

From these experiments, the following observation can be made:

1) Only fresh fish should be used for the production of light salted fish.

2) The salting operation is very important and should be made very carefully. It is one of the main factors for the final appearance of the product.

3) The period between salting and drying, when fish is piled up for dripping, should not be too long, especially if the fish is stored at ordinary temperature in a humid atmosphere. This period may be made longer at lower temperatures. An experiment is already in progress at the Station to find out the keeping quality of salted fish at various temperatures before drying.

4) If the method of drying described in appendix No. 15 is followed closely, good results should be obtained and light salted fish of the best quality should be produced.

5) The use of an air conditioned room for the press-piling operation does not seem to be absolutely necessary in the industry because greater quantity of fish are involved and equally good results are obtained in ordinary conditions.

6) After the drying operation, the fish should be packed and shipped as soon as possible because alteration of the surface may be encountered during storage. An experiment to find out the best keeping conditions for dried salted codfish is on the program for next year.

R. Legendre

Appendix No. 17

COMPARISON BETWEEN LIGHT SALTED CODFISH PRODUCED FROM ARTIFICIAL DRYING AND THAT PRODUCED FROM NATURAL DRYING

Many criticisms have been made upon the quality of light salted codfish produced from artificial dryers and for many people the only way to produce good quality Gaspé Cure is to use natural drying outside by exposing the fish to sun and wind on flakes. It is true that this kind of fish is not as easy to prepare as heavy salted codfish and in certain cases the criticisms arose from the fact that attempts have been made to dry Gaspé Cure in the same way and with the same dryer as used for the production of heavy salted codfish. This is impossible, because the rate of water evaporation is much higher with light salted fish and to maintain the required conditions in the dryer, it is necessary to increase considerably the quantity of air and heat supply. This fish contains less salt and the alteration in the quality occurs very rapidly if proper conditions are not used. However, the same is true for natural drying and serious losses may be encountered if the atmospheric conditions are not favorable. In fact, it is much more difficult to produce Gaspé Cure of the best quality by natural drying on the south shore of the Gaspé peninsula than it is on the north shore because the atmospheric conditions are more suitable there for this product and in general, the quality of the fish produced there is superior to that of the fish produced on the south shore.

Other arguments against artificial drying are that the colour and salt distribution on the surface are not the same and the general appearance differs from that of the fish dried naturally. If this is true, it should be possible to find out those which have been dried artificially from a group of samples which contain fish produced from the two different methods of drying. Such an investigation was carried on during the summer among fish producers and inspectors along the Gaspé Coast. The answers given by each group and results are shown in Table 1.

The fish submitted for this inspection contained a few numbered samples of five different groups of fish which are the following:

GROUP 1 - Fish produced in Grand River at the Station by natural drying on flakes.

GROUP 2 - Fish from Cloridorme where they usually obtain Gaspé Cure of the best quality from natural drying.

GROUP 3 - Fish produced in Paspebiac by natural drying.

GROUP 4 - Fish obtained from the experiments in Grand River on artificial drying of Gaspé Cure.

GROUP 5 - Fish obtained from the experiments in Paspebiac on the industrial production of artificially dried Gaspé Cure.

From the table it can be seen that the Gaspé Cure produced by artificial drying was not easily identified and as there were only two possibilities, we may conclude that the two different methods of drying give fish of identical appearance. For the fish dried artificially in Grand River,

TABLE 1

Group Number	Answers given and Errors in Percent								
Drying Method	Inspectors			Producers			Total		
	Natural	Artificial	Error	Natural	Artificial	Error	Natural	Artificial	Error
-1- Natural Grand River	29	1	3%	17	8	32%	46	9	16%
-2- Natural Cloridorme	5	1	17%	5	0	0	10	1	9%
-3- Natural Paspebiac	10	8	44%	10	5	33%	20	12	39%
-4- Artificial Grand River	34	25	58%	31	19	62%	65	44	60%
-5- Artificial Pilot Plant	7	47	13%	21	24	47%	28	71	28%

60% of the answers were incorrect and inspectors as well as producers did not identify it correctly. It seems that the inspectors had less difficulties with fish produced artificially in Paspebiac but samples were from the first experiment and as stated in appendix No. 16, this fish was not well salted and it is possible that their answers were influenced by this imperfection. If fish of the third experiment had been used, it is sure that the percent of incorrect answers would have been higher. Very fine results were obtained with the third experiment in Paspebiac, but it was not concluded in time to be included in this special inspection test.

R. Legendre

S E C T I O N III

SEAL OIL

Appendix No. 18

THE HYDROGENATION OF SEAL OIL

SUMMARY

The stability of hydrogenated seal oil is about the same as that of hydrogenated lard, i.e. about 20 hours in the testing apparatus; with the help of antioxidants, the stability increased 20 fold. Flavor reversion, although present is slight and in our opinion would go unnoticed in commercial products. The plasticity of certain fractions is just right for products like margarine and even better than vegetable oils in that connection. Partially hydrogenated oil offers possibilities as a canning oil for fish products.

In connection with the hydrogenation reaction proper, it may be reported that catalyst poisoning was encountered this year. Special experiments proved that refining was not the cause of it; however, the exact cause has not yet been determined. In order to continue the main research, the difficulty was temporarily skirted by slightly increasing the concentration of catalyst.

PART I - THE HYDROGENATION REACTION (continued from last year).

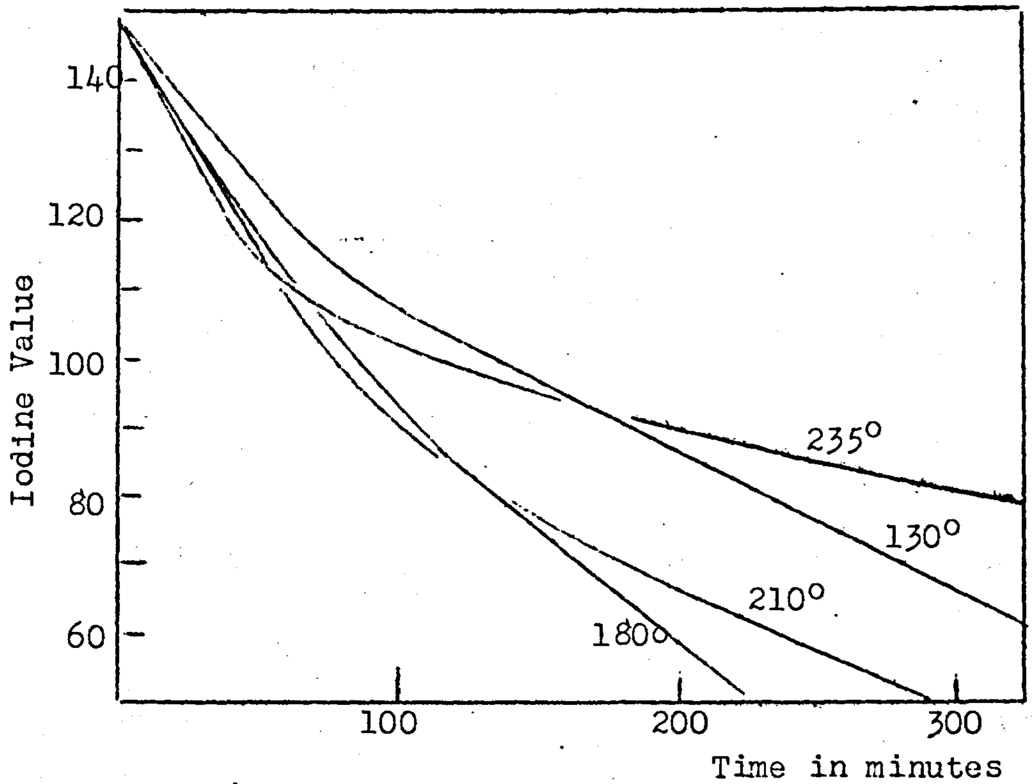
Two entirely new sets of hydrogenation conditions were tried, in an effort to improve the consistency of the hydrogenated fractions. The complete analysis of the samples was not performed since it is too time consuming, but with the help of iodine values and melting point these reactions were classified as to type of reaction.

The first set of conditions was as follows: 35 p.s.i., 180°C., 0.05% Ni; the low concentration of catalyst coupled with the relatively high pressure was expected to raise the melting points of the samples and increase their consistency range, and it did.

The second set of conditions was as follows: 5 p.s.i., 130°C., 0.1% Ni. The low temperature, coupled with the low catalyst concentration was expected to produce the same effect as the preceding experiment; it did, but not quite as markedly.

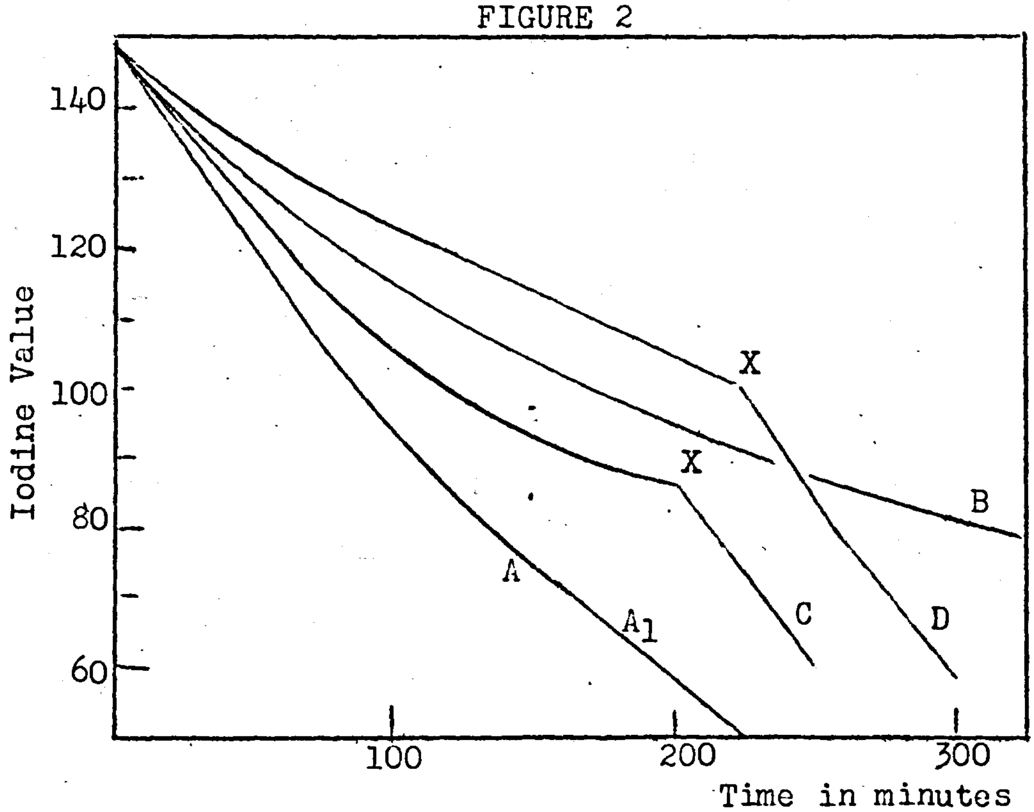
From these experiments, it is deduced that a temperature as low as possible (the reaction rate is reduced when the temperature is lowered, figure -1-) should be coupled with high pressure (above 35 p.s.i. where possible) to yield samples more closely resembling commercial shortenings. These

FIGURE 1



Reaction rate at different temperatures

FIGURE 2



A and A_1, normal reactions, same refining as B. C and D, abnormal reactions, addition of catalyst at X.

hydrogenating conditions would present great commercial interest in that heating costs would be lower and the reaction rate would be greater. Experiments under these conditions will be carried out as soon as a few accessories are secured for our hydrogenation unit.

Abnormal reactions: While hydrogenating oil for stability tests, under normal hydrogenating conditions, several reactions proceeded at an exceedingly low rate. Catalyst poisoning was suspected and this hypothesis was verified in the following manner: after allowing an abnormal reaction to proceed for a certain time, the reaction was stopped, a new portion of catalyst equivalent to the original portion was introduced, and the reaction was started anew. The reaction always resumed its normal course indicating that the catalyst had been spent. The effect of the addition of catalyst is shown in figure -2-.

With other types of oil such as vegetable oil, catalyst poisoning is usually reduced or eliminated by careful refining. The possibility that refining might be to blame was investigated by carrying out 3 successive reactions on the same batch of refined oil - see figure -2- where curves A and B represent oil of same refining, A is the average of two reactions; two reactions proceeded normally, but the third did not, indicating that the refining treatment could not be held responsible for the phenomenon. These abnormal reactions produced samples of higher melting point and of lower stability than those normally obtained; thus such reactions should be avoided. This phenomenon will be investigated further in order to find out its cause and if possible to prevent its occurrence in future. In the meantime double the usual concentration of catalyst has to be used in order to make sure that the reaction will proceed normally.

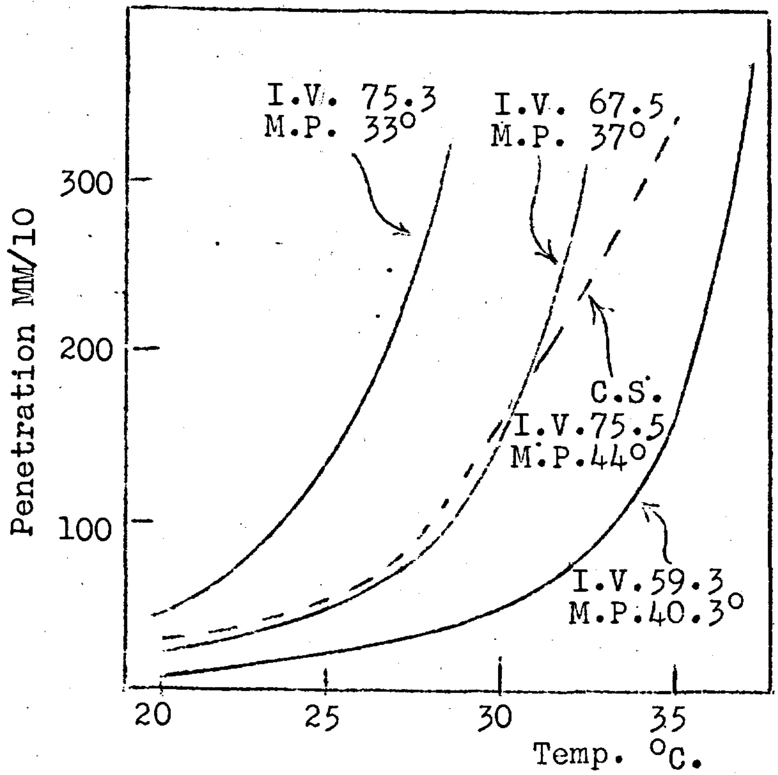
PART II - CONSISTENCY OR PLASTICITY

This is a characteristic of great importance in connection with shortening; the aim of manufacturers is to produce shortening which is soft at refrigerator temperature, and retains body at temperatures above 25°C.

The consistency of hydrogenated seal oil was determined with a needle penetrometer, designed by Bailey and Feuge. The test was applied not only to the samples of hydrogenated seal oil but also to a variety of commercial products, in order to obtain a means of comparison.

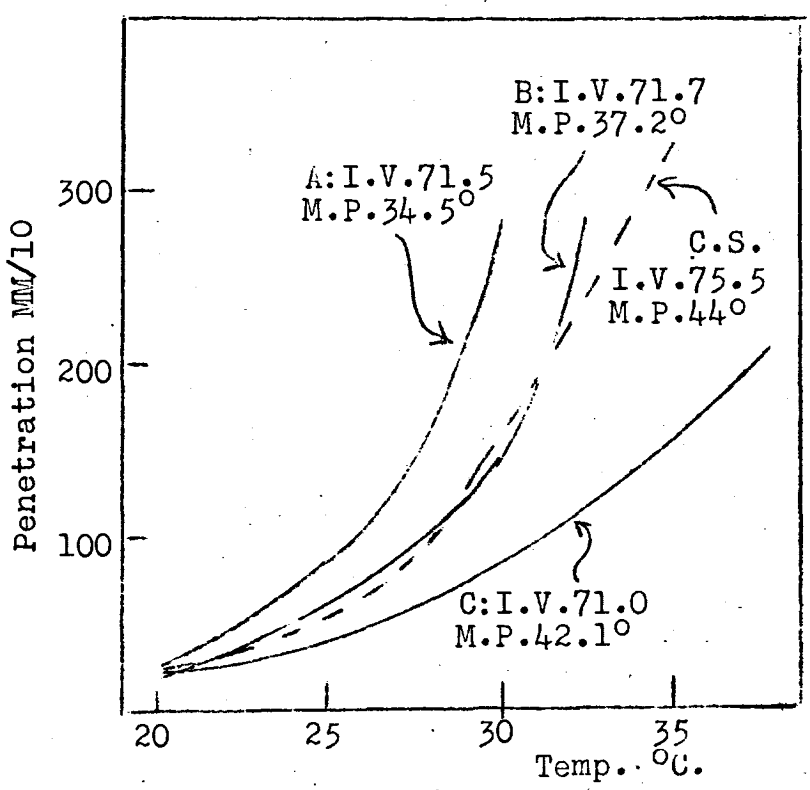
Figure -3- shows the variation in consistency at different temperatures for samples hydrogenated to various

FIGURE 3



Commercial shortening and fractions of hydrogenated seal oil.

FIGURE 4



Penetration of fractions of same iodine value. A - Straight hydrogenation. B - Equal parts of fractions 85-58 iodine value. C - Fractions 85-26 iodine value, 3:1 parts.

degrees of hardness; the consistency of a commercial shortening is included for comparison. It is to be noted that commercial shortening varies less in consistency over the range of temperatures, than do the samples of hydrogenated seal oil; shortening is softer at 15°C. and harder at 35°C. than the seal oil sample of iodine value 67.5 which follows approximately the same consistency curve. Notice also the higher melting point (7 degrees) of the shortening sample.

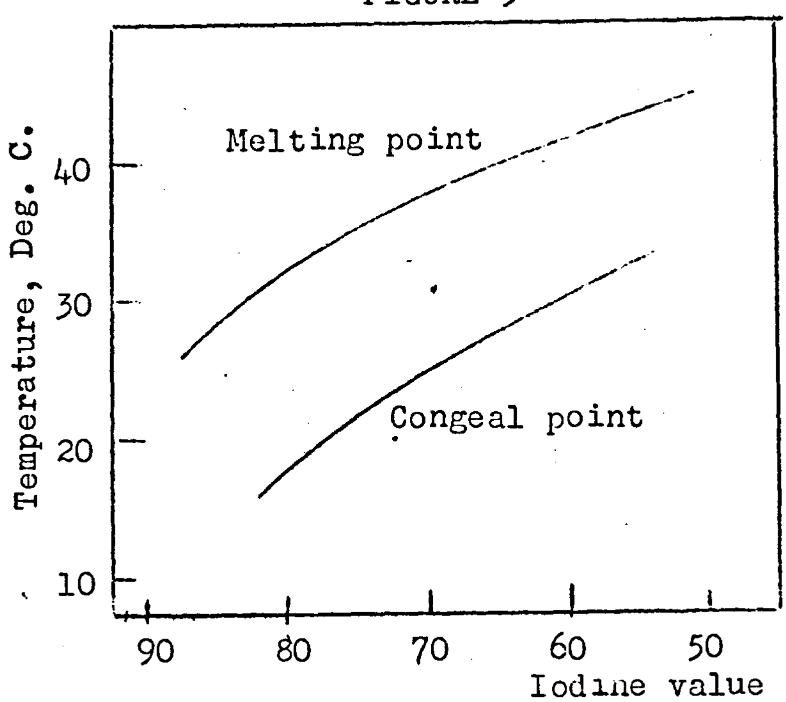
As it has been mentioned in section I an effort was made to find hydrogenation conditions which would produce samples more similar to shortening in consistency; these experiments showed that hydrogenating conditions which would produce more saturated acids should be sought, but they did not prove that hydrogenation conditions could be found which would yield products meeting the exacting requirement of shortening. Other hydrogenation conditions will be investigated but only those conditions which can be realized industrially; they will show whether shortening products can be obtained through straight hydrogenation or whether it will be necessary to resort to blending. The study of blending as an alternate procedure has also been attacked and enough data has been obtained to serve as a guide in the choice of the proper hydrogenated fractions in order to obtain products possessing definite consistency characteristics. Figure -4- shows the variation in consistency which it is possible to obtain through blending. Notice that the iodine values of the different samples are all approximately 71. Innumerable variations are of course possible, each slightly different from the next.

In connection with margarine, it seems that the industry relies more on congeal point determinations than on consistency. In figure -5- the variation in melting point of seal oil at different iodine values is compared to the variation in congeal point; it is seen that the interval between the two curves varies from about 12 degrees at the start to about 9 degrees at the end. In the vicinity of iodine values 70-75, the melting point of the samples are just right for margarine, but the congeal points are lower than those of commercial products prepared from vegetable oils. This is an advantage rather than a disadvantage, since butter has a lower congeal point than margarines. In fact, consistency determinations on hydrogenated seal oil and on butter show that identical curves may be obtained from both types of products by careful selection of the fraction of hydrogenated seal oil.

PART III - STABILITY

There are two kinds of deterioration which may affect oils containing unsaturated acids; a) oxidative rancidity and b) flavor reversion. Oxidative rancidity is due to the absorption of oxygen from the air by the unsaturated groups within the fat; the more unsaturation present in the fat, the quicker the absorption and the shorter its stability. Hydrogenation by reducing the unsaturation decreases the rate of absorption of oxygen and thereby increases the stability.

FIGURE 5

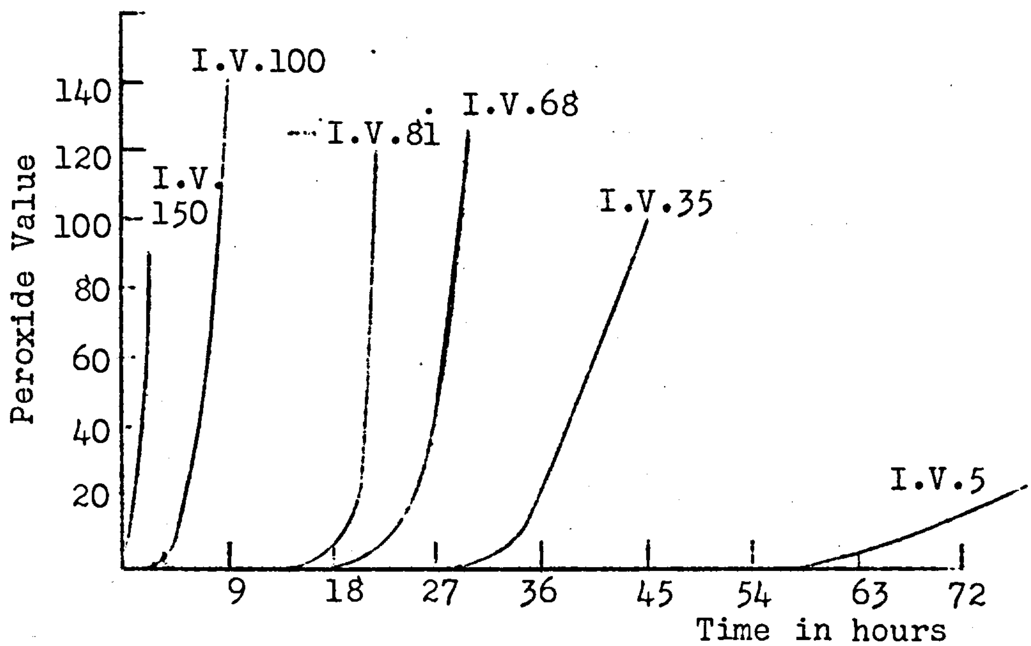


Melting point and congeal point variation in relation to iodine value.

Flavor reversion is a phenomenon which imparts a peculiar odor and taste upon a deodorized oil at a very low peroxide value. Hydrogenation is very effective in reducing this defect, and may even remove it entirely in some oils. The taste and odor of a reverted oil is different from that of the undeodorized oil and that of the rancid oil. Flavor reversion is said to be particularly noticeable in fish oils.

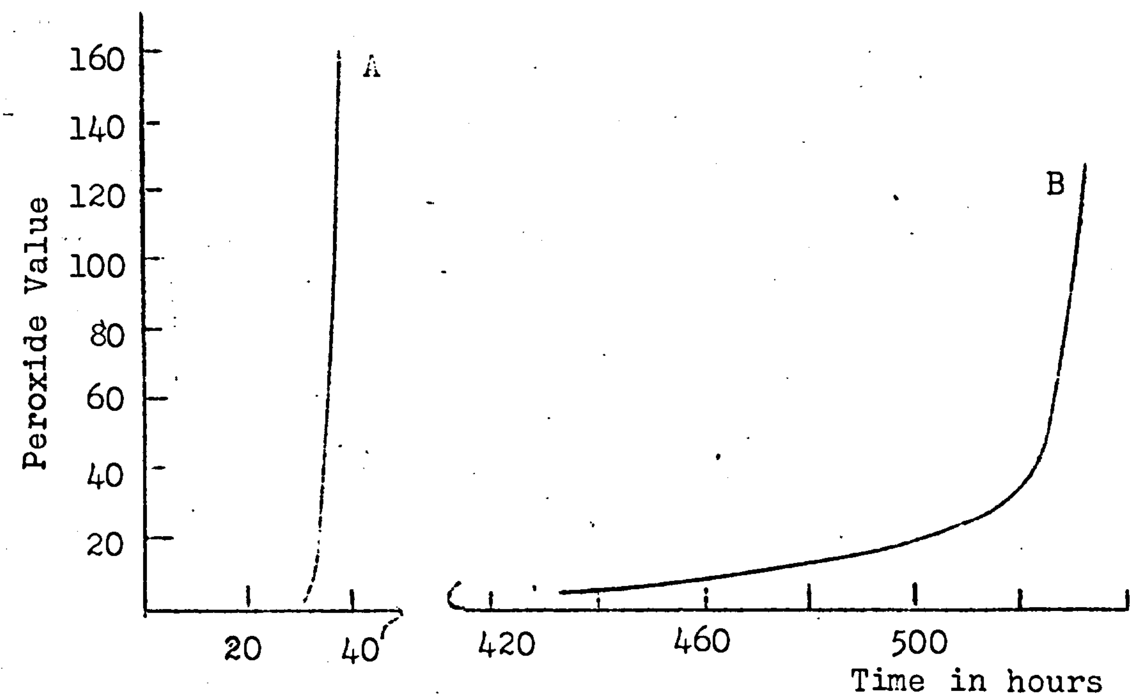
A: Oxidative rancidity. After a fat is packaged, several months of manipulation and storage under all sorts of conditions may elapse before it is finally eaten by a consumer.

FIGURE 6



Peroxide formation in Swift stability test apparatus for samples of different iodine values.

FIGURE 7



A - without antioxidant.
B - with 0.05% "Tenox II".

The consumer will judge the quality of the product by its taste and odor; that in effect is the only real test of the stability of a fat. However, since it is not always possible to use that method to evaluate new products, laboratory tests have to be relied on; they are based on chemical determinations and are used for predicting the probable stability of a fat or of an oil. One such test is the Swift stability test which was used extensively because it permits comparison of different samples between themselves and of fats of unknown stability with fats of known stability. The relation existing between the stability of a fat in the Swift apparatus and its stability under normal conditions has to be established anew for each new type of fat.

In hydrogenated seal oil, stability to oxidative rancidity is very poor until an iodine value of about 95 is reached; as the iodine value is reduced still lower, the stability increases to reach about 70 hours at iodine value 5.

Figure -6- shows the average stability of fractions hydrogenated to different iodine values; these values are by no means absolute since a few fractions of high iodine value (80) showed greater stability than some fractions of low iodine value (26). Such discrepancies prevented the use of this method for determining the relation if any between type of hydrogenation and the stability of the hydrogenated fractions.

Attempts were made to find out the cause for the variations mentioned previously. The following possible causes were investigated briefly: 1) Deodorization - undeodorized oil was only slightly less stable than deodorized oil 2) time of deodorization - no improvement was gained by doubling the time of deodorization 3) Period of storage after deodorization and before testing - this was found to have no effect on the stability 4) collection of samples from the hydrogenator under an atmosphere of inert gaz - no noticeable effect.

Hydrogenated seal oil was found to be as stable as hydrogenated lard. The low stability of this fat by comparison with vegetable oil is attributed to the fact that vegetable oils contain natural antioxidants. The addition of antioxidants is now becoming of almost universal use and the stability of oils in presence of antioxidants is at present of great interest. No special investigation was carried out to determine which antioxidant is best for seal oil; but the purpose was to have at least an idea of the protection which may be gained through the use of antioxidants.

It must be pointed out once again that an accelerated test does not necessarily represent what would actually take place under normal conditions of storage. This reservation must be kept in mind when stability is mentioned. Figure -7- shows the comparative stability of hydrogenated seal oil without and with antioxidant. Three different antioxidants were tested: Tenox II, N.D.G.A. and B.H.A. Table 1 lists the concentrations used and the results obtained. This shows that hydrogenated seal oil responds exceedingly well to antioxidants and becomes as stable as most vegetable oils. This is truly gratifying specially if the relation holds out under normal storage conditions.

TABLE 1

EFFECT OF ANTIOXIDANTS ON STABILITY

		Hours
N.D.G.A.	0.1%	800
Tenox II	0.05%	500
Tenox II	0.025%	290
B.H.A.	0.01%	100

B) STABILITY TO FLAVOR REVERSION

Flavor stability cannot be measured chemically; organoleptic tests are the only tests which may be used. But organoleptic tests may be relied on only under certain definite conditions which are becoming clearer as these tests come into more general use. At this Station, a tasting panel composed of fellow workers has been used intermittently, but the results must be confirmed by some other organization, because preconceived judgment in favor or against a product is often developped unconciously by people who know too much about the product being tasted.

The following experiments were carried out:

1) ultra-violet light causes flavor reversion in approximately 30 minutes. But the taste and odor are not the same as when the oil is stored in a closed container.

2) alternate heating up to 200°C. and cooling bring about a flavor reversion; this is a sweet smell somewhat like that of caramel. Four heatings are necessary to make it noticeable.

3) storing in glass bottles with ground-glass stoppers. The reverted flavor appeared 2 or 3 days after deodorization, same smell as in 2.

4) storing in closed containers in the absence of light - same effect as in 2.

5) frying doughnuts and potatoes in oil that had been stored for 3 months at 5°C. No flavor reversion was detected in the products.

6) canning of sardines in presence of this oil - no off flavor could be detected in the product stored in incubator at 37°C. for 5 months.

These results are in our opinion very encouraging and if the economic importance of the oil warrants it, more extensive tests should be carried out by an independent organization in order to confirm the contention that judging from the preceding results, hydrogenated seal oil is as acceptable as many products now on the market.

PART IV - APPLICATIONS

The hydrogenation of Seal oil has been studied with the purpose of determining the possibilities which this oil offers as an edible oil. Among the forms under which hydrogenated oils are used, the most important are: shortening, margarine, cooking and salad oil; and in connection with fisheries canning oil.

In the preceding sections of this report, it has been shown that seal oil fulfills the requirements of edible fats, as far as melting point, consistency and stability are concerned. But since edible fats are destined to be eaten, the appearance and the taste of the product in its ultimate form is also of great importance. It was therefore with this point of view in mind that actual processing of Seal oil down to the final product was undertaken.

Margarine: A laboratory preparation cannot be made to duplicate exactly the commercial product, but it may yield useful information.

The first attempt at preparing margarine yielded a product which tasters classified as "lardy", the crystal grain was coarse and the product did not melt readily in the mouth. This was attributed to the fact that the cooling of the fat had been too slow. In a second attempt, the margarine ingredients were well mixed in the fat and the temperature was allowed to fall to 32°C. before the mixture was poured into ice cube trays previously cooled to -10°F. The fat hardened immediately into a smooth, shiny fat just like butter. This product proved to be much more palatable than the preceding one;

it was submitted for appraisal side by side with butter and with commercial margarine and it may be reported that no marked preference was shown for any one of the products tasted.

The frying of doughnuts in an oil is said to be one of the most severe tests which can be applied to an oil to determine its acceptability. The seal oil which was used for these tests had been stored in the refrigerator for 3 months without antioxidant. The dough was prepared by a local bakery shop and the doughnuts were cooked until brown in the fat held at 180°C. Some were tasted immediately, but the rest were stored in a metal box in a cool room, and tasted each week. The taste of the freshly cooked doughnuts was rated as excellent and no off flavor could be detected in the stored doughnuts, after 4 weeks.

Canning Oil: Removal of the more saturated fraction which has crystallized out at room temperature yields a limpid oil from a sample of seal oil hydrogenated to an iodine value of 85. This oil was used as filler oil for canned sardines; the sardine packs were prepared according to the method advocated by Hess. The canned product may not have been of choice appearance, but it was of prime quality since it withstood storage at 37°C. for 6 months. The hydrogenated oil did not communicate any taste of its own to the pack. Thus it may safely be used for this purpose. It is suggested that the oil be protected with antioxidants to avoid deterioration during storage before going into the cans.

L. C. Dugal
C. A. Olivier

S E C T I O N   IV

MISCELLANEOUS

Appendix No. 19

IMPROVEMENTS OF FISH PROCESSING PLANTS

The improvements of the fishing methods could certainly bring a great development on the Gaspé Peninsula and in that field some experiments were made with larger boats by the Provincial Government. The success of these experiments begins to open the eyes of fishermen which seem to realize that great profits should be obtained from the use of larger and more modern boats. If larger boats are used, it will be easier to take the necessary precautions for the keeping quality of fish during transportation and a much greater quantity of landings will be possible. For that reason, it will soon become necessary to increase the capacity of several fish processing plants and some inquiries were already received from fish producers for engineering assistance in different projects of enlargement or construction of new plants.

Complete drawings were made for a project of increasing three times the capacity of a filleting plant and the necessary informations concerning the project were given to the officials concerned. The plant included a large chill room for the storage of fresh fish in boxes with ice before the filleting operation. The filleting plant was so arranged that a continuous line will be followed from the filleting tables to candling tables and the brining system. Three kinds of fillets can be produced in that plant: fresh fillets, frozen fillets and smoked fillets. Then, from the brine bath, part of the fish may go to the smoking room where is located the smoke-house and packing tables for smoked fillets. The other part goes to packing tables and from there the fresh fillet goes to another chill room where it is stored in boxes with ice until shipping. The third part goes directly to the cold storage which is located beside the plant. Provision was made for the utilization of by-products and the drawings included the necessary space for the construction of fish meal plant.

Other drawings were made for the construction of a complete fish processing plant near Grand River. The installation includes a filleting plant, a salting plant with provision for the preparation of light salted and heavy salted fish and a drying plant. The work of construction was undertaken during the summer and the setting up of the salting plant is under way. The filleting plant and drying plant will be added later when circumstances permit.

R. Legendre

Appendix No. 20

SMOKING

Two smoking plants were installed during the year; one in Paspebiac and the other in Cap-des-Rosiers. Drawings were made and complete information given as to the location of the unit, warm air furnace, smoke generator and auxiliary equipment in the smoking room. In Paspebiac an annex adjacent to the existing filleting plant was constructed for the smoking room and in Cap-des-Rosiers the smoke-house was constructed in a small room between filleting and salting plants. In both places, the unit installed is the Halifax type cross-ventilated tunnel smoke-house. In Paspebiac, the installation was in operation for the major part of the fishing season and nice product was obtained.

During the summer, an experiment was made in Grande Rivière on the use of "Fumeol" for the production of smoked cod fillets. The solution was prepared by using 20 gm of "Fumeol" for 1000 c.c. of solution. After a brining of 5 minutes at 40°F., cod fillets were soaked in the "Fumeol" solution. Different soaking times were used and part of the fillets were removed from the solution after one hour and a half. Finally, the fillets were placed in the artificial dryer for a drying of 6 hours at 80°F. and 55% relative humidity. At the end of the operation, the fish has about the same color and taste as that produced of the usual manner in smoke houses and it seems that best results are obtained with a soaking of half an hour. But the appearance of the fillets is not so good. The "Fumeol" is a new product used in France for the preparation of various kinds of smoked fish. However, here in Canada, with the good results obtained with the kind of smoke-house used, it does not seem very advantageous of using this new method of smoking. With the "Fumeol" process a dryer is necessary and the labour operation is about the same.

R. Legendre

Appendix No. 21

CONTROL OF QUALITY OF FROZEN FISH

The analysis of fresh and frozen fish samples taken by Provincial Government Inspectors, was again the main feature of our Analytical Services. As in the previous years, random sampling was done from time to time in the production lots ready for shipment.

Again trimethylamine determinations served as an index of the quality of the fish and grading was made on the basis of the number of parts per million. Last year, Grade "A" represented perfectly fresh fish and included all that having between 0 and 20 p.p.m. trimethylamine. In grade "B" from 20 to 40 p.p.m. of trimethylamine, slight alteration was indicated. But this year, in an effort to stimulate the production of better quality frozen fillets, the standards were raised so that grade "A" fish now includes only that having from 0 to 10 p.p.m. trimethylamine and grade "B" that having from 10 to 40 p.p.m. The other grades "C", "D" and "E" are essentially the same as last year.

On account of reduced personnel in the Analytical Service, the same number of samples as last year could not be handled. In all, only 225 samples were received for analysis, but this small number did not interfere with the production of frozen fillets which was approximately the same as last year. The accompanying table summarizes the results obtained in the grading of frozen cod fillets.

Grade	Number of samples	%
A	85	37.7
B	128	57.0
C	10	4.4
D	2	0.9
E	0	0

From the results shown above, it appears that with the new limits of trimethylamine imposed on grade "A", a smaller percentage of the total number of samples has been placed in this category. But we note that grades "A" and "B" represent almost 95 per cent which is approximately the same as that obtained last year for these two grades. These results indicate that the frozen cod fillets produced during the season were of good quality.

Although improvements are always possible, it seems that under the present limitations, it would be very difficult to obtain better results than those obtained in the last two years.

A. Nadeau

S E C T I O N   V

LIST OF PUBLICATIONS

PUBLICATIONS

The following papers have been published or submitted for publication during the year.

Dugal, L.C. and Cardin, A.	"Influence de la température et du temps de désodorisation sur quelques propriétés de l'huile de phoque (Phoca Groenlandica) et en particulier sur la stabilité". J. Fish. Res. Bd. Can. (in press)
Dugal, L. C.	"Hydrogenation of Seal Oil". Trade News Vol. 4, No. 5, p.9-10
Dussault, H. P. and Lachance, R. A.	"Improved medium for Red Halophilic bacteria from salt fish". J.Fish. Res.Bd.Can. (submitted)
Fougère, H.	"Studies on salting I-The salt and water exchange in codfish muscle". J.Fish. Res.Bd.Can. (submitted)
Fougère, H.	"Salting codfish I-Some consideration on heavy salt pickled fish". Atl. Progress Report (submitted)
Fougère, H.	"Salting codfish II-Gaspé Cure". Atl. Progress Report (submitted)
Fougère, H.	"Salting codfish III-An economic aspect of the industry". Atl. Progress Report (submitted)