

# BOTULISM AMONG ALASKA NATIVES IN THE BRISTOL BAY AREA OF SOUTHWEST ALASKA:

## A survey of knowledge, attitudes, and practices related to fermented foods known to cause botulism

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### ABSTRACT

**Objectives.** Botulism cases due to traditional Alaska Native fermented foods occur periodically in Southwest Alaska. In this population, we conducted a survey on knowledge, attitudes, and practices related to botulism and fermented foods. **Methods.** We interviewed 140 adults randomly chosen from nine villages. Data collected included fermented food consumption frequency; knowledge about the cause and symptoms of botulism; and fermented food preparation methods. **Results.** Most respondents (81%) had eaten Alaska Native fermented foods at least once. Over 70% identified botulism as a foodborne illness, and over 87% believed eating certain Native fermented foods could cause botulism. One-third of fermented food preparers used plastic containers for fermentation. To prevent botulism, 45% would consider boiling fermented foods, and 65% would not eat foods fermented in plastic or glass containers. **Conclusions.** Despite high awareness of botulism in this population, one-third of fermented food preparers use plastic containers, a practice which may increase the risk of botulism. Misconceptions and acceptable prevention messages about botulism, such as using traditional non-plastic fermentation methods, were identified and included in an educational video. (*Int J Circumpolar Health* 2002; 61:50-60)

In the United States, foodborne botulism is a rare illness that most frequently arises from consumption of improperly made home-canned foods (8). In Alaska, botulism is more common and the majority of cases have been asso-

ciated with the consumption of traditional Alaska Native fermented foods such as fermented fish heads, beaver tail, or seal flipper (1). Cases have also been linked to seal oil and dried fish. The incidence of botulism in Alaska is the highest in the country and is nearly 20 times higher than in Washington, the state with the next highest rate (4). In Alaska, the annual incidence of botulism has increased in recent years, from 5.6 cases per 100,000 population in 1980-1984 to 10.7 cases per 100,000 population in 1995-1997 (1). Cases periodically occur in the Bristol Bay area of Southwest Alaska where 1.3% of the states' population resides (12).

People living in rural Alaska often practice a subsistence lifestyle, depending heavily on self-caught fish and animals for food. Traditional fermented foods are an integral aspect of the Alaska Native culture; reports of fermented food consumption in Alaska villages date as early as 1878 (1). A typical traditional fermented food recipe consists of placing food products in either a grass-lined hole in the ground or a wooden bucket or woven basket buried in the ground outdoors. After several weeks, the food is ready for consumption. In recent years, anecdotal reports suggest that food has increasingly been placed in plastic buckets or bags for fermentation. Some food preparers place their plastic containers indoors to further hasten the fermentation process at warmer temperatures (7, 10, 11). It is hypothesized that the increased usage of plastic containers, which promote an anaerobic environment in which *Clostridium botulinum* thrives, has contributed to the increased incidence of botulism in Alaska (2, 11).

The characteristics of botulism cases in Alaska, along with the implicated food items, differ from cases elsewhere in the country. The majority of botulism cases in Alaska are caused by *C. botulinum* strains producing type E toxin. Type E strains account for only 10% of all botulism cases in the United States (4), yet 79% of cases in Alaska from 1950-1997 were caused by type E strains (1). Compared to toxin types A and B, the two types mainly responsible for foodborne botulism elsewhere in the United States, botulism attributable to type E tends to be less severe with a shorter incubation period (13). Spores of *C. botulinum* type E have been found throughout Alaska in beach soils and fish, whereas the presence of types A and B has not been demonstrated (3, 5).

Few data are available which document Native fer-

mented food preparation and consumption practices in the Bristol Bay area of Southwest Alaska. In order to assess these practices as well as the knowledge and attitudes of area residents toward botulism, a survey of adults in nine rural villages in the Bristol Bay area was conducted in the spring of 1999. The results were used to develop specific prevention messages for an educational video produced by the Centers for Disease Control and Prevention (CDC) and the Bristol Bay Area Health Corporation (BBAHC).

## METHODS

This survey to assess knowledge, attitudes, and practices pertaining to foodborne botulism was developed and pilot-tested among Alaska Natives in the Bristol Bay area. The final survey included data regarding demographic characteristics; frequency of consumption of Native fermented foods; and methods of preparing Native fermented foods. Knowledge of botulism as a foodborne illness was assessed by the use of an open-ended question ("What is botulism?") along with additional specific questions about the cause, symptoms, risk factors, and treatment of botulism. Other than gender and age group, no personal identifying information was collected. Community health representatives, who are employed by BBAHC and provide health promotion and disease prevention education to residents in their villages, assisted with wording issues. BBAHC is a Native-operated health organization which provides health services to residents in 34 communities in Southwest Alaska. The predominant ethnic group in the BBAHC service area is Yup'ik Alaska Native.

Nine villages in the Bristol Bay area were selected for participation, and these included villages in which botulism cases had occurred or where Native fermented foods were known to be prepared and consumed. A population-based 8% random sample of persons aged 18 years or over was generated for each village using the patient roster of the BBAHC medical records system. Population estimates for 1998 were obtained for the participating villages from the Alaska Department of Labor (12). The total number of residents in the nine selected villages was 2,729. The mean village population was 303 persons, with a range of 81 to 801.

All surveys were completed in April and May, 1999. The surveys were conducted in person by six trained interviewers from CDC and BBAHC. Ninety-one percent of the interviews were conducted in English. Non-English speakers were surveyed using an interpreter.

Survey information was entered into a Microsoft Access database. Statistical analysis was performed using Epi Info (Version 6; Centers for Disease Control and Prevention, Atlanta, GA). Comparisons between categorical responses were made using the Chi-square test. All *P* values shown are two-tailed.

## RESULTS

### *Demographics*

A total of 140 surveys were collected from the nine participating villages. More than half of the respondents were aged 30-49 years (Table 1), and 60% were male. The age and gender distributions of the survey respondents did

Table 1. Demographic characteristics of entire survey sample (n=140) and survey respondents who identified themselves as preparers of Native fermented foods (n=38): Bristol Bay area, Southwest Alaska, 1999.

All survey respondents (n=140)			Fermented food preparers (n=38)		
Characteristic	n	(%)	Characteristic	n	(%)
Age, years			Age, years		
18-29	21	(15.0)	18-29	2	(5.3)
30-39	39	(27.9)	30-39	10	(26.3)
40-49	39	(27.9)	40-49	12	(31.6)
50-59	23	(16.4)	50-59	10	(26.3)
60-69	12	(8.6)	60-69	2	(5.3)
70 and over	5	(3.6)	70 and over	2	(5.3)
Unknown	1	(0.7)			
Ethnic Group <sup>a</sup>			Ethnic Group		
Yupik	111	(79.3)	Yupik	33	(86.8)
White	17	(12.1)	White	0	(0.0)
Athabaskan	12	(8.6)	Athabaskan	4	(10.5)
Aleut	4	(2.9)	Aleut	0	(0.0)
Other	3	(2.1)	Other	1	(2.6)
Gender			Gender		
Male	84	(60)	Male	17	(44.7)
Female	53	(37.9)	Female	21	(55.3)
Unknown	3	(2.1)			

<sup>a</sup> Percentages add to over 100 % because several respondents identified themselves with more than one ethnic group.

Table II. Number and percentage of respondents (n=124) identifying specific symptoms as those of botulism: Bristol Bay area, Southwest Alaska, 1999.

Symptom	n	(%)
Nausea	107	(86.3)
Weakness	105	(84.7)
Vomiting	102	(82.3)
Blurry vision	90	(72.6)
Diarrhea	87	(70.2)
Trouble breathing	82	(66.1)
Slurred speech	78	(62.9)
Fever <sup>a</sup>	73	(58.9)
Double vision	71	(57.3)
Trouble swallowing	68	(54.8)

<sup>a</sup> Fever is not a symptom of botulism

not differ significantly from that of the general Bristol Bay adult population ( $P>0.05$ ). Seventy-nine percent of those interviewed were Yup'ik Alaska Natives.

### Knowledge

When asked the open-ended question "What is botulism?", fifteen percent (21/140) of survey participants responded that they did not know; however, 71% (99/140) responded correctly that botulism is a foodborne illness. Most respondents correctly identified common symptoms of botulism (Table II). The exception was fever, which 59% incorrectly classified as a symptom of botulism.

Respondents were asked if consumption of specific foods could cause a person to become ill with botulism. The majority of respondents (range = 87%, 96%) believed that consumption of certain Native fermented foods could cause botulism, but fewer respondents believed that eating seal oil (58%, 72/124) or dried fish (20%, 25/124) could result in botulism poisoning. Some foods not typically associated with botulism were identified by respondents as potential causes; 54% of respondents (67/124) implicated packaged food from the store, and 31% (38/124) believed that eating fried chicken could cause botulism.

Nearly 30% of respondents (37/124) suggested that consumption of other foods could also cause botulism. Foods identified as high risk included spoiled or unclean meat; other fermented foods such as fermented whale meat or kimchee; raw chicken; eggs; shellfish; spoiled mayonnaise; unwashed foods; and foods that are stored and subsequently heated in plastic containers or plastic wrap. Six percent (7/124) said that botulism could result when a person ate certain foods in combination, such as Native fermented foods eaten with sweet foods, soda pop, coffee, or fruit.

Respondents were asked what they could do to prevent themselves from becoming ill with botulism after consuming contaminated Native fermented foods. One-third of respondents (41/124) reported that they would vomit and/or drink water (n=31); drink milk (n=5); take aspirin (n=1); eat fruit (n=1), seal oil (n=1) or another food (n=1); or drink a homemade concoction of soap and water (n=1). Nearly all respondents (121/124) said that people of any age could get botulism. The majority of re-

spondents (112/123) reported that if they suspected botulism, even after taking possible preventive measures, they would seek medical attention. Ninety percent of respondents (111/124) believed that a person with botulism could be cured, and of these respondents, 99% (110/111) believed that medical personnel, such as doctors, nurses, and community health aides, could treat individuals with botulism. When asked about treatment for botulism, 6% (7/111) knew that antitoxin was utilized, and 3% (3/111) believed that antibiotics were used in the treatment of botulism.

More than half of respondents (66/124) said that there is no immunity to botulism, but 23% (28/124) thought that some people were protected from becoming ill with botulism. Two-thirds of this latter group (18/27) believed that persons who do not eat Native fermented foods, who are careful about which fermented foods they do eat, or who prepare their fermented foods in a safe manner are protected from becoming ill with botulism.

### *Consumption Practices*

Respondents were asked questions regarding their consumption practices of five Native fermented foods, seal oil, and dried unsalted fish (Table III). Eighty-one percent of respondents (112/139) reported having ever eaten any of the five fermented foods (95% Confidence Interval [CI] = 73%, 87%). The proportion of respondents reporting Native fermented food consumption, defined as those who consume fermented foods sometimes or whenever possible, increased with increasing age ( $P=0.013$ ), from 24% of those aged 18-29 to 71% of those aged 60 and over.

Table III. Consumption habits of traditional Alaska Native foods by 140 survey respondents: Bristol Bay area, Southwest Alaska, 1999.

Name of food	Never consumers		Ever consumers			
	n	(%)	Past consumers		Consumers <sup>a</sup>	
	n	(%)	n	(%)	n	(%)
Fermented fish heads	32	(22.9)	43	(30.7)	65	(46.4)
Fermented beaver tail	73	(52.1)	40	(28.6)	27	(19.3)
Fermented seal flipper	86	(61.4)	26	(18.6)	28	(20.0)
Fermented fish eggs	115	(82.1)	14	(10.0)	11	(7.9)
Fermented walrus flipper	116	(82.9)	15	(10.7)	9	(6.4)
Seal oil	16	(11.4)	7	(5.0)	117	(83.6)
Dried unsalted fish	15	(10.7)	7	(5.0)	118	(84.3)

<sup>a</sup> The category "consumers" includes respondents who consume the foods "sometimes" or "whenever I can"

Table IV. Proportion of respondents reporting consumption of Native fermented foods by age group: Bristol Bay area, Southwest Alaska, 1999.

Age Group	Consumers of fermented foods <sup>a,b</sup>	
	n	(%)
18-29 (n=21)	5	(23.8)
30-39 (n=39)	22	(56.4)
40-49 (n=39)	23	(59.0)
50-59 (n=23)	13	(56.5)
60 and over (n=17)	12	(70.6)
Total (n=139)	75	(54.0)

<sup>a</sup> P value for increasing trend: 0.013

<sup>b</sup> The category "consumers of fermented foods" includes respondents who consume the foods "sometimes" or "whenever I can"

Fermented fish heads were the most commonly consumed Native fermented food, with 77% (108/140) of respondents reporting ever having consumed them (95% CI = 70%, 84%) (Table III). Of respondents who had ever consumed fermented fish heads, 44% (47/108) had eaten them at least once during the past year (95% CI = 34%, 53%). Beaver tail was the second most commonly consumed fermented food, eaten at least once by 48% of respondents (67/140). Only 22% (15/67) of those respondents had consumed it during the past year.

Seal oil and dried unsalted fish were other frequently consumed Native foods, eaten by nearly 90% of respondents. Of respondents who reported ever having consumed seal oil, 45% (56/124) had eaten it eleven or more times in the past year. Of respondents who reported ever having consumed dried unsalted fish, 42% (52/125) of respondents had eaten it eleven or more times in the past year.

### Preparation Practices

Twenty-seven percent of respondents (38/140) reported that they prepared fermented foods. More than half of the preparers (17/38) were female ( $P=0.01$ ). Fermented fish heads were the most commonly prepared fermented food, made by 36 of 38 Native fermented food preparers, followed by beaver tail ( $n=5$ ), seal flipper ( $n=4$ ), and whole fish ( $n=3$ ). Thirty-two of the 36 fermented fish head preparers gave detailed recipes about the procedure used. Nearly 85% of the fermented fish head recipes (27/32) included other salmon parts, such as intestines, liver, eggs, or milt. In addition, 25% of recipes (8/32) included salt, either by adding it directly to the fish heads or soaking the heads in salted water.

Eighty percent of preparers who provided recipes (26/32) rinsed the fish heads in water before beginning the fermentation process. The heads were then placed in a container, such as a plastic bucket ( $n=11$  recipes), wood barrel ( $n=11$ ), or hole in the ground ( $n=8$ ). Of the 11 recipes which used plastic buckets, eight specified that instead of an airtight plastic lid, a cloth or burlap covering or no covering at all was used. Plastic buckets were placed in a cool, shaded area, such as in or underneath a storage shed or smokehouse (8/11), or buried in the ground (3/11). All fermented fish head recipes which utilized a hole in the

ground specified the use of grass to line the holes and to cover the fish heads.

The length of fermentation was approximately two weeks, but recipes reported a range of three days to “all winter”. Readiness was assessed by the smell of the food (n=9 recipes) as well as the appearance, such as a change in texture (n=5), reddening of the fish eyes (n=4), or the presence of white spots inside the fish heads (n=3). Smell and appearance also indicated if the fish heads were overdone; fermented fish head preparers reported a strong or rotten odor (n=11), soft texture (n=10), or a green color to the food (n=4) as indications of overfermentation. Two recipes specified that consumption of overdone fermented fish heads caused one’s throat to burn.

Many recipes (14/32) specified that fermented fish heads were washed before being eaten and that they were eaten with dried fish (9/32). Ten recipes reported that food not eaten immediately was left in the ground or bucket for a subsequent meal. Six recipes specified that fish heads not eaten within a few days were frozen for later consumption, but six other recipes specified that the extra food was thrown away.

### *A t t i t u d e s*

Seventy-seven percent of respondents (96/124) believed that they were at risk for botulism from eating Native fermented foods, seal oil, or spoiled foods. Four respondents mentioned during the interview that when they are served fermented foods by friends or family, they feel it is inappropriate to ask about how the foods were prepared, although this information was not specifically sought.

Respondents were asked whether there were practices that would decrease the risk of botulism from traditional Alaska Native foods. Nearly half of the respondents (53/117) would consider boiling fermented foods before eating them. However, 75% of respondents (75/116) would not heat seal oil before using it. Eating fermented foods only if they were not prepared in glass or plastic containers (65%) and in cool conditions (64%), and eating dried or smoked fish only if salted (53%) appeared to be acceptable to most respondents.

## DISCUSSION

This survey was conducted in the Bristol Bay area of Alaska, an area with one of the highest rates of botulism in the world. Prior to our survey, few data on knowledge of botulism and fermented food preparation and consumption practices in this area were available (6, 7). We found that awareness of botulism in the area was high; most respondents knew that botulism is a food-related illness and that traditional Alaska Native fermented foods have been associated with botulism. Over three-fourths of respondents reported consuming fermented fish heads and of those, nearly half had eaten them at least once in the previous year.

One in three persons who prepared fermented fish heads reported using plastic containers which could create an anaerobic environment conducive to botulinum toxin production. Prevention messages that were acceptable to over one-half of respondents included not eating foods fermented in plastic or glass containers and only consuming foods that had been kept cold during the fermentation process. Additionally, nearly half of respondents would consider boiling fermented foods before eating. These findings have formed the basis for a health education campaign designed to reduce the risk of botulism from traditional fermented Alaska Native foods.

It has been postulated that fermented foods are eaten more frequently by older Alaska Natives compared to younger persons. Shaffer et al. (1990), surveyed 45 Alaska Native high school students and found that only 15% of students reported regular consumption of Native fermented foods compared to 71% of their parents and 80% of grandparents (7). In our survey, the proportion of respondents reporting consumption of Native fermented foods increased with increasing age ( $P=0.013$ ), from 24% of those aged 18-29 to 71% of those aged 60 and over. Based on this finding, educational materials were produced in both English and Yup'ik, the local Native language, because older persons may be less likely to speak English.

Fish is an important component of the diet and culture in rural Alaska Native villages. Nobmann et al. (1992) administered dietary intake recall questionnaires for 351 Alaska Native adults in 11 communities (6). Fish was found to be the fourth most frequently consumed food, with Alaska Natives consuming six times more fish than the

general U.S. adult population. Forty-two percent of respondents reported having consumed fermented foods at least once in their lives, as compared to 81% in the current survey. One explanation for this difference is that the current survey was conducted solely among persons living in rural Alaska Native villages while the Nobmann study included Natives living in the larger cities within the state. Commercially produced foods are less accessible in rural villages, each of which usually has only one small grocery store, and village residents may be more likely to practice a subsistence lifestyle and to consume traditional Native foods than those living in urban areas. Additionally, consumption of traditional foods may have increased with heightened interest and acceptability of traditional Native customs during the period between the two surveys.

Language barriers were a concern when conducting the surveys in this primarily Yup'ik-speaking population. No person was denied participation because of a language barrier; an appropriate interpreter was utilized in these instances. However, certain words used in English, such as "botulism", are not easily translated into the Yup'ik language. One source mentioned that the word "botulism" literally translates as "illness from fermented foods" in Yup'ik. Therefore, surveys that were conducted in Yup'ik may systematically differ from those conducted in English. Additionally, information about those who did not participate in the survey was not collected; it is unknown whether the nonrespondents differed systematically from those who participated.

Past educational efforts have addressed the diagnosis and prompt treatment of persons with botulism. Efforts to educate the Alaska Native population about the risk of botulism from Native fermented foods appear to be partly successful. Survey respondents were generally knowledgeable about the causes and clinical manifestations of botulism. The survey suggested that not all Native fermented food preparers were aware of the risk of using plastic buckets in their preparation practices. Although no fermented food is completely without some risk of causing botulism, controlled microbiologic experiments indicate that the traditional method of fermenting fish heads in a grass-lined hole in the ground is less likely to result in botulinum toxin production (CDC, unpublished data). Though most plastic bucket users reported using what they considered to be a non-airtight lid, using any impermeable

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container during the fermentation process should be discouraged, whereas more traditional practices appear to be safer and should be promoted.

The goal of this survey was to identify primary prevention messages which will be aimed at Native fermented food preparers and consumers. These prevention messages were included in a culturally appropriate educational video and health education campaign that CDC and BBAHC have developed for Alaskans. Previous experience suggests that video is an acceptable and effective method of health communication for Alaska Natives (9). Future assessments are planned to document the impact of this campaign on fermented food preparation practices. Additional information on the health education campaign can be found on the Internet at <<http://www.cdc.gov/ncidod/aip/aip.htm>>.

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