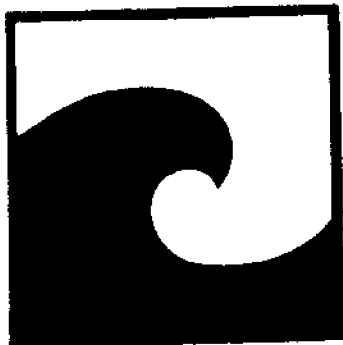# Seafood Newburg

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Development of Products from
Underutilized Species of Fish: Booklet 14

This is one in a series of booklets
on minced fish products written for
people in the food processing industry.

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DEVELOPMENT OF PRODUCTS FROM UNDERUTILIZED

SPECIES OF FISH

14. SEAFOOD NEWBURG

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ACKNOWLEDGEMENTS

CONTENTS

FIGURES AND TABLES

ABSTRACT

The possibility of using underutilized fish and seafood in a gourmet convenience food, frozen seafood newburg sauce, was explored. Modified starch, a hydrocolloid, a cream replacer, and several types of sherry were investigated for use in the sauce. Species and form of fish suitable for use in newburg sauce were studied.

Sauce prepared with freeze-thaw stable food starch, the hydrocolloid (xanthan gum) and a cream replacer was smooth and stable to freezing and reheating. Cream sherry cooked down before addition of other ingredients provided good, delicate flavor. Many species of underused fish and seafood, if good quality, were found by taste panels to be suitable in newburg sauce. Mechanically deboned fish, if properly formed, was as acceptable as fish fillet flakes in the product.

The formula for preparation of frozen seafood newburg is included. Approximate nutritive composition is shown. The product is suitable for retail sales or institutional use.

INTRODUCTION

Seafood Newburg is the second gourmet type product developed during the course of our continuing project on finding uses for underutilized species of fish and other seafood.

Seafood Newburg is a variation on the more elegant and expensive Lobster Newburg. Legend has it that Lobster Newburg or Wenberg was first prepared in about 1877 by sea captain Ben Wenberg at Delmonico's Restaurant in New York City. After Wenberg and the owner had a falling out, the popular dish was renamed Lobster Newberg (McClane and deZanger, 1977). Now the spelling is usually "Newburg" and other newburgs besides lobster abound. One can find shrimp, crab, clam or seafood newburgs on restaurant menus and frozen at the grocery store.

The original dish consisted of sauteed lobster in a heavy cream sauce thickened with egg yolks and flavored with madeira wine and other seasonings. There are variations of this recipe in which the sauce is thickened with flour and butter (Beard, 1976; McClane and deZanger, 1977).

We proposed to develop a frozen seafood newburg containing fish and shellfish by products, such as shrimp pieces. Since a sauce thickened with egg yolks is rather fragile and might very well curdle under conditions of freezing and reheating, we decided to thicken the sauce with

1

a modified food starch. Sauces made with commercially modified food starches are stable to freezing, thawing, and reheating, whereas sauces made with flour or unmodified starches may break down to a spongy texture and release water (syneresis) after freezing (Wurzburg, 1972).

We chose to retain butter in the formulation for its rich flavor, but we replaced heavy cream with non-fat dried milk and a cream replacer. The effect of the hydrocolloid, xanthan gum, on sauce stability was studied because of its reported stabilizing characteristics in emulsions (Stanislav and Sheets, 1971) and starch gels (King, 1983). A New York State cream sherry was chosen for the wine because its flavor is close to a Madeira (Mattick, 1982). As in previous studies (Baker and Kline, 1983), we precooked all fish and shellfish used in the product.

Various flavor bases and synthetic red color were used. We noted the effect of form and texture of the fish used in the sauce and compared several underutilized species.

2

GENERAL PROCEDURES

Materials

The fish used throughout the development of this
product was pollock (Pollachius virens). Several other
ocean and freshwater species were compared for use in the
newburg, as well. These were: Blackfish (Tautoga onitis),
channel catfish (Ictalurus punctatus), cod (Gadus morhua),
smooth dogfish (Mustelus canis), mechanically deboned (MD)
white sucker (Cotostomus commersoni), MD northern pike
(Esox lucius), ocean perch (Sebastes marinus), MD Pacific
salmon (Oncorhynchus species), red hake (Urophycis chuss),
silver hake (Merluccius bilinearis), white hake (Urophycis
tenius), and whiting (Menticirrhus saxatilis). Japanese
surimi, mock crab made from surimi, and small shrimp or
shrimp pieces were also used.

The cod, pollock, blackfish, dogfish, perch, red hake,
silver hake, white hake, whiting and mock crab were obtained
from Long Island sources. The catfish came from an aquafarm
in Mississippi. The MD white sucker came from either Lake
Cayuga, Ithaca, NY or from Manitoba, Canada. The MD white
pike was obtained from Manitoba Canada and the surimi and MD
salmon came from the state of Washington.

All mechanically deboned fish (raw), mock crab and
surimi arrived frozen. We cut the products into 114-227

gram (four – eight ounce) portions and stored them at -23°C (-10°F) until needed. The catfish arrived as raw, frozen fillets and were stored frozen until needed. The remainder of the fish species usually arrived fresh on ice, either dressed or filleted. Skinning and filleting was done where needed and the fish were cooked by steaming (10 minutes per 2.5 cm (1 inch) maximum thickness). After draining a few minutes, the fish was packaged in 114 gram (four ounce) portions and frozen a short time until used.

For use in the Newburg Sauce, mechanically deboned fish, catfish and surimi were thawed, baked on a covered tray in an electric oven at 191°C (375°F) until just done, drained, and broken up into various sized pieces as described later. Frozen shrimp was cooked briefly in boiling water, drained, and any shell removed. Precooked fish were thawed, broken up, weighed, and put directly into the sauce.

Preparation of Frozen Newburg Sauce

Table 1 shows the starting formula for the frozen newburg sauce. Throughout much of the development the product was prepared as follows:

1. Sherry was reduced to one-half, then butter was melted in the pan.

2. Fish, seafood (26 percent and 11 percent of weight of sauce, respectively), and oil were added and sauteed briefly, then the pan was removed from the heat.

3. Dry ingredients were slurried with the water and fish broth and added to the pan with the fish, butter, and sherry.

4. The mixture was cooked until thickened, packaged in plastic ice cream containers with lids, and frozen for one week before serving to the taste panel.

Table 1. Starting Formula for Frozen Newburg Sauce

Ingredients	Percent
Water	37.20
Cooking sherry [1]	18.87
Fish broth	14.15
Butter	13.45
Non-fat dry milk	8.14
Vee-Kreme [2]	3.66
Modified corn starch [3]	2.87
Vegetable oil	0.79
Seafood Flavor, 7815 [4]	0.54
Salt	0.30
White pepper	0.03
Seafood [5]	

1 Holland House Brands Co, Ridgefield, NJ.
2 Fidco, White Plains, NJ.
3 Consista brand, Staley Manufacturing Co., Decatur, IL.
4 Spectra brand, Fidco, White Plains, NJ.
5 Seafood: Fish was 26% by weight of sauce and shrimp was 11% by weight of sauce.

As development progressed cayenne (red pepper), a mushroom base (#050-20 Castle and Cooke, Inc., 50 California St., San Francisco CA 94111), and a shrimp base (L.J. Minor Corp., 436 Bulkey Bldg., Cleveland, OH 44115) were added. A synthetic red color (Roxanthin Red 10, Hoffman-La Roche, Inc., Roche Chemical Division, Nutley NJ 07110) was made up as a concentrated solution according to the the directions

of the manufacturer and one to two milliliters added to the sauce.

Xanthan gum (Keltrol brand, Kelco, Inc., Div. of Merck and Co., Inc., 8355 Aero Dr., San Diego, CA 92123) was added to insure stability of the frozen, thawed sauce. The Keltrol was slurried in 1-2 grams vegetable oil, dispersed in the vortex of some of the water component in a Waring blender, and mixed for seven minutes on speed two to insure hydration of the gum. This mixture was then combined with the dry ingredients and the remainder of liquid components and added to the saucepan.

Measurement of Viscosity

A Brookfield Viscometer model LVF (Brookfield Engineering Laboratories, Inc., Stoughton, MA 02072) was used to measure the viscosity of just thickened sauces, without seafood, held at 53°C (127°F) in a lowform 600 milliliter beaker. Three readings were taken at different locations in the beaker after four revolutions of the number four spindle traveling at six revolutions per minute. Brookfield readings were multiplied by 1000 to convert the units to centipoise. Sauces with two different levels of modified starch and zero and four levels of xanthan gum were measured before and after freezing to assess thickness and stability to freezing.

7

Sensory Evaluation

Sensory evaluation of the newburg sauces was done by an eight to ten member panel, both male and female, who had from one to many years experience judging food products. Panels were conducted in a well-lit room at individual booths with water, celery, and unsalted soda crackers available for use between samples.

Precooked, frozen newburg sauces were thawed and heated to serving temperature with gentle heat and frequent stirring on an electric range. Sauces were served over warm toast points or rice on coded styrofoam plates. Depending on the experiment panelists used a hedonic scale from nine to one to rate the samples for parameters such as color, appearance, texture , seafood texture, flavor, and overall desirability. Nine represented the best scores, one represented the poorest scores. Figure 1 shows a representative score sheet.

Name_____

Date_____

Product_____

Sample Code
x   o   /

Appearance
9 8 7 6   5 4 3 2 1
Excellent   Poor
Appetizing   Unappealing

Texture
9 8 7 6   5 4 3 2 1
Excellent   Poor

Flavor
9 8 7 6 5 4 3 2 1
Like   Dislike
extremely   extremely

Overall Desirability
9 8 7 6 5 4 3 2 1
Like   on the   Dislike
extremely   fence   extremely

Comments:

Figure   1   Representative   Score   Sheet   Used   for   Taste
              Paneling

9

Statistical Analysis

Mean taste panel scores were subjected to an analysis of variance. Differences among sensory scores for various treatments were tested by the F test of the analysis of variance ($p \leq 0.05$). If significant differences were indicated by the F test, the Least Significant Difference test was used to determine which treatments actually differed from each other ($p \leq 0.05$) (Snedecor and Cochran, 1967).

Nutritive Value

The nutritive value of the ingredients in the final seafood newburg formulation was calculated using Agricultural Handbook No. 456 (Adams, 1975).

DEVELOPMENT OF FROZEN SEAFOOD NEWBURG SAUCE

1. Formulation of Sauce

Modification of Starting Formula

Several preliminary taste panels not reported here were run to judge the effects of small changes in the starting formula. Cayenne (or red pepper, 0.01 percent) and a mushroom base (0.50 percent) were added because they enriched the flavor of the sauce. The mushroom base gives the sauce a slight brown color note. Red food color (0.006 percent) was used to give a light salmon pink hue thought to be associated with seafood sauces.

Table 2 shows results for a taste panel comparing a seafood flavor and a shrimp base used in the starting formula (Table 1) and also the shrimp base in the starting formula and a Minor Company formula. There were no significant differences among the scores, but the shrimp base scored a little higher than the seafood flavor for all parameters when used in the same formula. Our formula compared favorably with the Minor Company formula. After this we used the shrimp base as well as a fish base (L.J. Minor Co.) or fish broth to enhance seafood flavor.

The amount of butter was reduced. Even combined with starch modified for freeze-thaw stability, there was some butter separation from the sauce. The original amount was probably in excess of what the starch-water matrix could hold.

11

Table 2 Taste Panel Scores[1] for Frozen Seafood Newburg
Sauce Prepared with Pollock, Two Different Seafood
Flavor Bases, and Two Formulas

Treatment	Parameters			
	Appearance	Texture	Flavor	Overall Desirability
Starting formula Seafood flavor[2]	7.3[5]	7.4	7.2	7.3
Starting formula Shrimp base[3]	7.5	7.5	7.4	7.7
Minor formula Shrimp base[4]	7.0	7.2	7.6	7.1

1 A nine point scale was used for taste panel scores,
the higher numbers denoting more desirable attributes.
A ten member panel evaluated the samples.

2 Spectra 7815, Fidco, White Plains, NY

3 Minor shrimp base, L.J. Minor Corp., Cleveland OH.

4 Formula contained in L.J. Minor Co. recipe booklet.

5 There were no significant differences among the
scores ($p \geq 0.05$).

Sauce Stabilization with Xanthan Gum

Often we noticed slight separation of the sauce after
freezing and reheating, therefore we decided to incorporate
xanthan gum to increase sauce stability. Several taste
panels were run to determine if the xanthan gum changed the
sauce in any way. Table 3 shows the results of one such

panel. There was no significant difference among the scores, although there was a slight trend towards better texture and appearance for the samples containing xanthan gum. The separation of frozen, reheated sauce we had noted was generally not observed by the panel members, thus no great differences in scores were expected for texture and appearance. The same results were found for other panels not reported here. It appears that the sample with 0.1 percent xanthan gum had slightly better flavor and overall desirability than the control and the sample with 0.2 percent gum. However, other panels, also with no statistically significant differences among scores, often showed the opposite results, thus it was not considered a real difference. We concluded from the panels and from our own observations that at these levels xanthan gum enhances frozen sauce stability and causes no important change in other characteristics of the sauce.

Table 3   Taste Panel Scores [1]   for Frozen Seafood
Newburg Sauce Prepared with Ground Pollock and
with and without Xanthan Gum

| | Parameters | | | |
Treatment	Appearance	Texture	Flavor	Overall Desirability
No addition	7.1[2]	7.1	7.4	7.1
Xanthan gum, 0.1%	7.4	7.3	7.6	7.5
Xanthan gum, 0.2%	7.4	7.5	7.1	7.2

1   A nine point scale was used for taste panel scores,
the higher numbers denoting more desirable attributes.
A ten member panel evaluated the samples.

2   There were no significant differences among the
scores ($p \geq 0.05$).

Viscosity Measurements and Decrease in Starch

We observed and panelists commented that the sauce was
too thick when the original level (3.0 percent) of starch
was used, especially after xanthan gum was added. We
prepared sauces with ingredients shown in Table 1, but
without fish, flavor bases, or pepper. Each contained 3.0
or 1.5 percent starch, respectively and 0.00, 0.05, 0.10,
0.15 percent xanthan gum, respectively, at each starch
level.   Viscosity values, as measured by the Brookfield
Viscometer, are shown in Figure 2. As expected, the higher
starch produced a more viscous sauce.   Viscosity increased

with increasing xanthan gum and leveled off between 0.10 and 0.15 percent gum. This was unexpected when these results were compared to the manufacturers viscosity data for xanthan gum (Anonymous, 1984). In pure xanthan gum solutions in distilled water with salt added in the range used here, viscosity increases up to 3.0 percent. Perhaps some other sauce component modified the viscosity under our conditions. Also, the Revolutions Per Minute (RPM) of our Viscometer was set for six RPM and that of the gum manufacturer (same model) was set for 60 RPM. This may contribute to the difference in results. Regardless, the level of xanthan used here increased the viscosity of the sauce and this is important to know for a potential manufacturer of this product.

Figure 3 shows viscosity of a similar set of sauces containing 1.5 percent starch before and after freezing. Zero and four concentrations of xanthan gum were used. Results were similar to those for the samples with 1.5 percent starch shown in Figure 2 with a leveling off at the higher concentrations of gum. What is important to note is there was little change in viscosity after freezing, indicating that the sauce
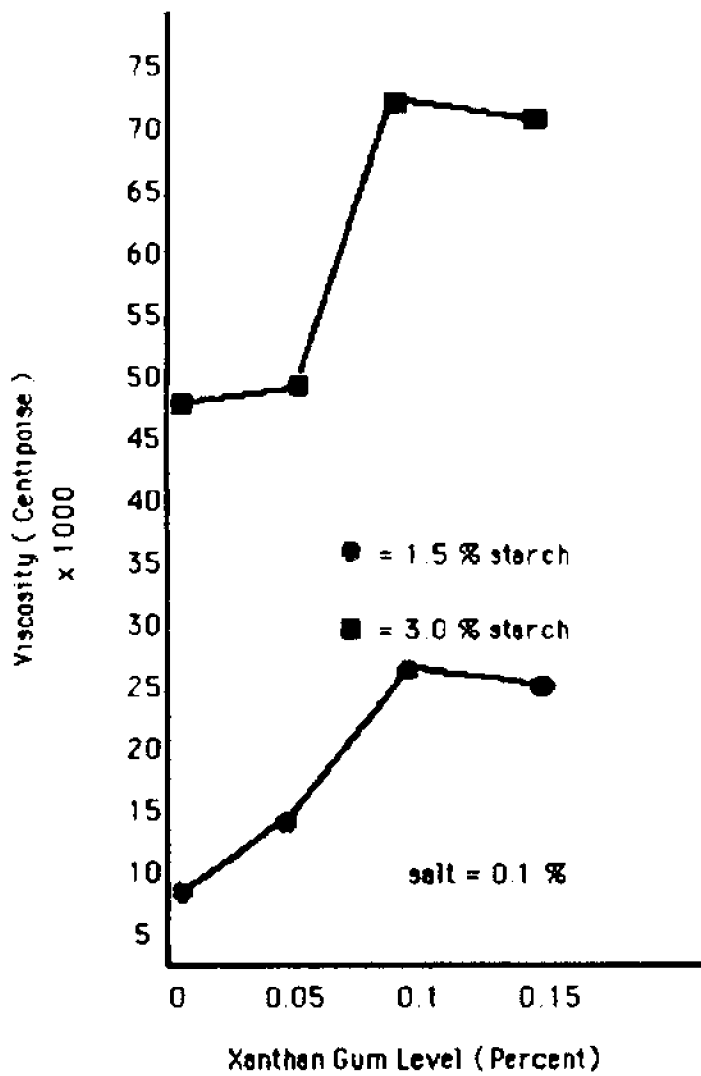
Figure 2 Viscosity of Newburg Sauces Containing Two
Levels of Starch and Various Levels of
Xanthan Gum.
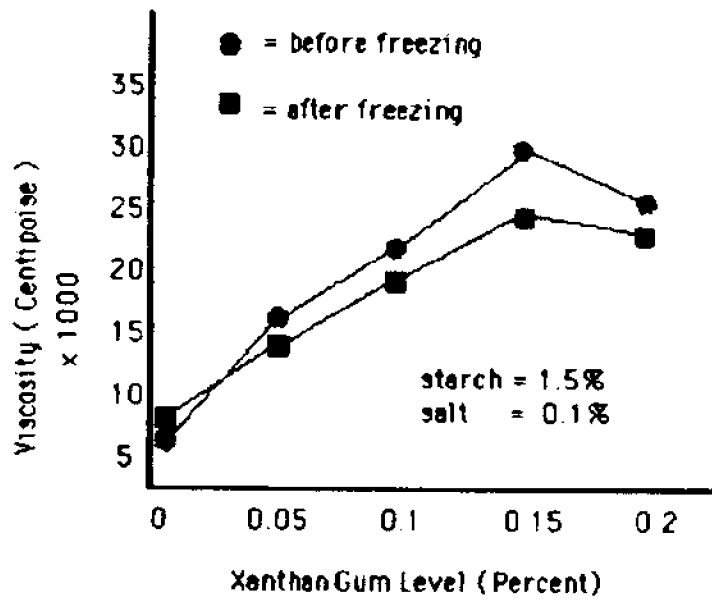
Figure 3 Viscosity of Newburg Sauces Containing Various
Levels of Xanthan Gum Before and After Freezing.

remains stable during the freeze-thaw process. From this point 1.5 percent modified starch and 0.2 percent xanthan gum were used in the newburg sauce.

Use of Cream or Cream Substitutes

A manufacturer might be interested in comparing light cream and substitutions for cream in the newburg sauce. Table 4 shows sensory scores for sauces made with cod, shrimp pieces, and mock crab (surimi) with one of the following for the cream component:

Light cream (20% fat, 64% of sauce part).

Non-fat dry milk plus Vee Kreme (65.7% of sauce part).

Non-fat dry milk only (60.8% of sauce part).

Vee Kreme made to cream strength (40 parts Vee Kreme to 60 parts water, 64% of sauce part).

Though there were no statistically significant differences, sauce with light cream was rated slightly higher than the others for sauce texture and overall desirability. Sauce with nonfat dry milk plus Vee Kreme compared quite well with sauce with light cream and received the highest score for appearance. Some panelists preferred the translucent sheen of the sample with only nonfat dry milk compared with the more creamy appearance of other samples. But that sample received the lowest score for appearance, sauce texture, flavor, and overall desirability. Scores for all four samples were close for flavor and overall desirability. These panel results indicate that

18

using a substitute for light cream in seafood newburg is quite acceptable.

Table 4 Taste Panel Scores[1] for Frozen Seafood Newburg Sauce Prepared with Different Ingredients for the Cream Component.

	Parameters			
Ingredient	Appearance	Sauce Texture	Flavor	Overall Desirability
Light cream	7.6[2]	8.0	7.6	7.7
Nonfat dry milk plus Vee Kreme	8.0	7.9	7.5	7.6
Nonfat dry milk	7.3	7.3	7.4	7.3
Vee Kreme, 40:60 water	7.5	7.5	7.6	7.4

1 A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. An eight member panel evaluated the samples.

2 There were no significant differences among the scores ($p \geq 0.05$)

Table 5 shows taste panel results for sauces made with nonfat dry milk plus a small amount of Vee Kreme or with 40 parts Vee Kreme to 60 parts water and with and without xanthan gum. Scores were similar for both cream substitutes for all sensory parameters. Though there were no significant differences, there was a slight trend towards higher scores for sauces containing 0.2% xanthan gum for appearance and texture.

19

Table 5 Taste Panel Scores [1] for Frozen Seafood Newburg Sauce Prepared with Different Ingredients for the Cream Component and with and without Xanthan Gum.

Ingredient	Appearance	Sauce Texture	Flavor	Overall Desirability
Nonfat dry milk,plus Vee Kreme	7.1 [2]	7.1	7.4	7.1
Nonfat dry milk plus Vee Kreme and 0.2% Xanthan gum	7.4	7.5	7.6	7.2
Vee Kreme/water (40/60)	7.1	7.2	7.4	7.1
Vee Kreme/water (40/60) plus 0.2% Xanthan gum	7.5	7.5	7.6	7.5

1. A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. A ten member panel evaluated the samples.

2. There were no significant differences among the scores $(p \geq 0.05)$.

In case a processor wanted to sell a so called "natural" seafood newburg with real cream, we prepared seafood newburg with light cream and heavy cream with and without 0.2% xanthan gum, and froze and reheated the samples. A careful visual observation was made. Both samples with xanthan gum were slightly thicker, and smoother than the samples without the gum. Those without the gum

while quite acceptable and stable after freezing and reheating, exhibited tiny butter droplets throughout the sauce. The xanthan gum definitely contributes to a smoother, probably more stable frozen sauce.

Type of Sherry Flavor and Method of Addition

The necessity of using real sherry wine and its method of addition to the sauce were investigated. Table 6 shows taste panel results for samples with sherry flavor from:

Sherry extract (Virginia Dare brand) added in amount recommended by the manufacturer

Cream sherry added and concentrated as described earlier.

Cream sherry (same amount) simply added to sauce at the end of the cooking period, not concentrated.

The treatments had no effect on color or texture of sauce. Flavor was greatly affected with the score for the sauce with cooked down cream sherry being statistically significantly better than the other two scores. The same trend was apparent for overall desirability, though differences weren't significant at the 0.05 percent level. The sauce with the extract was said to have little or no sherry flavor. Some panelists said it tasted sweet, like a dessert flavor. The sauce with the cream sherry added at the end of preparation had too much alcohol taste, because the alcohol would not have been driven off by cooking. Concentrating cream sherry, then adding other ingredients, clearly develops a good sherry flavor, while eliminating the

21

alcohol. We screeneu several sherry substitutes, but found
none comparable to real sherry. A processor might want to
further investigate this aspect of the product.

Table 6 Taste Panel Scores[1] for Frozen Seafood
Newburg Sauce Prepared with Sherry Extract and
Cream Sherry Added Two Ways.

	Parameters			
Treatment	Color	Sauce Texture	Flavor	Overall Desirability
Sherry Extract	$7.7^{2,a}$	7.4^a	6.3^a	6.7^a
Cream Sherry, cook down	7.6^a	7.4^a	8.0^b	7.6^a
Cream Sherry, add at end	7.8^a	7.7^a	6.5^a	6.7^a

1 A nine point scale was used for taste panel scores,the
higher numbers denoting more desirable attributes. A ten
member panel evaluated the samples.

2 For each parameter a and b differ significantly
($p \leq 0.05$).

2. Species and Form of Fish

Form: Optimal Use of Mechanically Deboned Fish

Preliminary work indicated that consumers might object
to the homogeneous "ground meat" appearance and mouthfeel of
mechanically deboned (MD) fish used in this product where
it can be readily seen. Mechanically deboned fish would

appear like ground meat if it were added raw to a sauce and stirred well into it. In our situation where the fish is precooked by baking to avoid the dilution problems of cookout, the MD fish sets into a solid mass during cooking. Thus, one can chop, grind or cut it into various sizes and shapes.

Tables 7, 8 and 9 show taste panel scores for a group of texture experiments where newburg sauce with flaked pollock fillet plus shrimp pieces as a control was compared to newburg sauce with MD white sucker or MD white pike plus shrimp pieces. (Sucker and pike fillets were not available. Since all three species are bland flavored, we thought there would be little flavor difference between sauces). For the experiment shown in Table 7 the precooked "minced" sucker was made to look like ground meat by chopping into small pieces. "Large grind" was produced with a kitchen meat grinder so that the pieces were approximately 14-19 millimeters (1/2-3/4 inch) long by 14 millimeters (1/2 inch)in diameter. "Knife cut" was cut into irregular shapes, rather like fish fillet flakes, 3 millimeters (1/8 inch) thick and 14-19 millimeters (1/2-3/4 inch) wide and long. Appearance, seafood texture and shape, and overall desirability scores were significantly lower for the "minced" fish than for the other three treatments. Flavor scores were about the same for all samples. The white sucker used here was from Lake Cayuga. It was recently mechanically deboned and frozen in our laboratory, and was

23

of excellent quality, hence the good flavor.

The "minced" MD white pike (Table 8) was prepared like the "minced" sucker. The 14 millimeter (1/2 inch) pieces were broken irregularly by hand, ("hand shaped") instead of grinding, and the "knife cut" pieces were made as for the sucker in the previous experiment. The precooked pike did not grind well; it became mashed in the grinder.

Table 7 Taste Panel Scores [1] for Frozen Seafood Newburg Sauce Prepared with Flaked Pollock Fillet or Mechanically Deboned (MD) White Sucker Formed into Different Sized Pieces

| Sample/Size | Parameters | | | |
	Appearance	Texture,Shape	Flavor	Desirability
Pollock fillet, flaked	$8.2^{2,b}$	7.8^{b}	7.4^{a}	7.7^{b}
White sucker (MD)Minced, 1/8-1/4"	6.2^{a}	5.6^{a}	7.6^{a}	6.3^{a}
Large grind, 1/2-3/4"	7.6^{b}	7.8^{b}	7.7^{a}	7.7^{b}
Knife cut, 1/8-1"	7.8^{b}	7.4^{b}	7.8^{a}	7.5^{b}

1 A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. A ten member panel evaluated the samples.

2 For each parameter a and b differ significantly $(p \leq 0.05)$.

Table 8 shows taste panel results for newburg sauce prepared with the four textures of fish. In this panel the newburg with the "minced" fish received significantly lower scores for seafood texture and shape. Scores for appearance and overall desirability were also the lowest for this treatment, though not statistically significantly so. Flavor scores were all about the same. The MD white pike from Canada used here was of very good quality, thus its flavor compared well with the pollock fillet.

Table 8 Taste Panel Scores [1] for Frozen Seafood Newburg Sauce Prepared with Flaked Pollock Fillet or Mechanically Deboned (MD) White Pike Formed into Different Sized Pieces.

		Parameters		
Sample/Size	Appearance	Seafood Texture,Shape	Flavor	Overall Desirability
Pollock fillet, flaked	7.7 [2,a]	8.0 [b]	7.3 [a]	7.3 [a]
White pike (MD):				
Minced, 1/8-1/4"	7.4 [a]	6.8 [a]	7.4 [a]	6.9 [a]
Hand shaped, 1/2"	7.9 [a]	7.9 [b]	7.4 [a]	7.6 [a]
Knife cut, 3/4-1"	7.7 [a]	7.7 [b]	7.6 [a]	7.3 [a]

1 A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. A seven member panel evaluated the samples.

2 For each parameter a and b differ significantly ($p \leq 0.05$)

Table 9 shows sensory scores for a second texture experiment with white pike. The "knife cut" pieces were somewhat larger than those in the previous sauce with pike (Table 8), however.

The "minced" fish sauce received significantly lower scores for appearance compared to the sauces with pollock and "hand shaped" fish, but not compared to the "knife cut" fish sauce. The newburg with "minced " fish received

significantly lower scores for seafood texture and shape than did the other newburgs. The newburg with pollock fillet scored higher than any of the sauces with sucker for flavor and overall desirability, although the differences weren't statistically significant.

Table 9 Taste Panel Scores[1] for Frozen Seafood Newburg Sauce Prepared with Flaked Pollock Fillet or Mechanically Deboned (MD) White Sucker Formed into Different Sized Pieces

Sample/Size	Appearance	Seafood Texture, shape	Flavor	Overall Desirability
Parameters				
Pollock fillet, flaked	7.6[2,c]	8.0[b]	7.4[a]	7.5[b]
White Sucker (MD):				
Minced, 1/8–1/4"	6.4[a]	6.1[a]	7.1[a]	6.4[a]
Hand shaped, 1/2"	7.4[b,c]	7.5[b]	6.9[a]	6.8[a,b]
Knife cut, 1"	6.9[a,b]	7.3[b]	6.8[a]	6.5[a]

1 A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. An eight member panel evaluated the samples.

2 For each parameter a, b, and c differ significantly ($p \leq 0.05$)

The MD white sucker used for this experiment was not of the highest quality; it had a fishy note when tasted plain and was somewhat darker than the sucker we processed. We think this influenced the scores for appearance for the

sauce with "knife cut" fish and for flavor and overall desirability for all sauces with sucker. Also, the "knife cut" fish pieces may have been too large. Some panelists commented on " large, reconstituted, or artificial" looking fish pieces. The size of the pieces also emphasized the darker color of this batch of MD white sucker. "Large, dark pieces" in that sauce sample were noted by a panelist as "unappealing."

Conclusion: Form of Fish

Panelists prefer whole, flaked fish or the appearance thereof in a newburg sauce. Many commented that they like discrete seafood pieces, irregular in shape and size. The pieces should be neither too large or too small. Panelists did not like sauce in which the fish looked like "hamburger". They disliked the uniform look of it or the mouthfeel. Their comments indicated that panelists presented with seafood newburg expected it to be somewhat elegant with various shapes and sizes represented by the seafood. With a little imagination, mechanically deboned fish can be made into suitable shapes of seafood newburg.

The results of the third experiment with the white sucker emphasized the necessity of using fresh or good quality frozen fish in a product like seafood newburg. A delicate sauce cannot cover up poor color and deteriorated flavor.

Different Species

Several species of fish either as fillet flakes or mechanically deboned (MD) made into 14 millimeter (1/2 inch) shapes were compared in the newburg sauce. Tables 10, 11, 12 and 13 show taste panel results for four trials. When sauces containing cod, pollock, ocean perch, and silver hake were compared (Table 10), no statistical differences in scores were found for any parameter except texture of the silver hake. It was thought to be softer than the other species. This lowered the overall score for that sauce, but the flavor of the sauce with silver hake scored as well as the other samples. The scores were quite acceptable on a scale of nine, indicating any of those four species would be suitable for use in seafood newburg.

Table 10 Taste Panel Scores[1] for Frozen Seafood
Newburg Sauce Prepared with Different Species of
Fish and Shrimp Pieces

| | | Parameters | | |
| | | | | Overall |
Species	Appearance	Texture	Flavor	Desirability
Cod	7.6[2,a]	7.5[b]	7.1[a]	7.4[a]
Pollock	7.8[a]	7.3[a,b]	7.3[a]	7.4[a]
Ocean perch	7.8[a]	7.9[b]	7.1[a]	7.5[a]
Silver hake	7.6[a]	6.6[a]	7.3[a]	6.9[a]

1 A nine point scale was used for taste panel scores,
the higher numbers denoting more desirable attributes.
An eight member panel evaluated the samples.

2 For each parameter a and b differ significantly
($p \leq 0.05$).

Table 11 shows panel scores for newburg sauces containing
pollock fillet flakes, surimi chunks, mock crab chunks, and
catfish fillet flakes. Clearly, the rather musty catfish
flavor in the sauce was unacceptable to this taste panel of
people from the northern United States and this affected the
score for overall desirability for the sauce, as well. The
panel found the texture of the mock crab in the sauce to be
too stringy and small, but scored appearance, flavor and
overall desirability as high as or higher than the other
species. We probably cut the mock crab too finely. It
should be left in more discrete chunks.

Table 11 Taste Panel Scores[1] for Frozen Seafood Newburg Sauce Prepared with Different Species of Fish and Shrimp Pieces

Species	Appearance	Seafood Texture	Flavor	Overall Desirability
Pollock, fillet	$7.0^{2,a}$	7.4^{b}	7.0^{b}	6.7^{b}
Surimi	7.6^{a}	7.4^{b}	6.4^{b}	7.0^{b}
Mock Crab	7.6^{a}	6.6^{a}	7.3^{b}	7.2^{b}
Catfish, fillet	7.2^{a}	$6.9^{a,b}$	3.0^{a}	4.8^{a}

1 A nine point scale was used for taste panel scores, the higher the numbers denoting more desirable attributes. A nine member panel evaluated the samples

2 For each paramater a and b differ significantly ($p \leq 0.05$)

Sauces with surimi and pollock received good scores, although the flavor score of the sauce with surimi was somewhat low. Surimi has a definite sweet note which can be detected in more delicately flavored dishes. Its white appearance and suitable texture are good qualities for sauce and soup type dishes. Pollock, as before, was found to be quite acceptable in the sauce.

Table 12 shows sensory scores for newburg sauces containing pollock and dogfish fillet flakes, as well as and MD salmon, MD white pike, and MD white sucker. The pollock,

31

pike, sucker, and dogfish received quite acceptable scores for all parameters. There were some significant differences for appearance, but many overlapped statistically, and all

Table 12 Taste Panel Scores[1] for Frozen Seafood Newburg Sauce Prepared with Different Species of Fish, Shrimp Pieces, and Mock Crab

		Parameters		
Species	Appearance	Texture	Flavor	Overall Desirability
Pollock, fillet	7.7[2,a,b,c]	7.6[b]	7.9[a]	7.7[b]
Salmon, MD	7.2[a]	6.2[a]	6.9[a]	6.6[a]
White pike, MD	8.1[c]	7.9[b]	7.8[a]	7.9[b]
White sucker, MD	7.4[a,b]	7.8[b]	7.7[a]	7.6[b]
Dogfish, fillet	7.8[b]	7.6[b]	7.7[a]	7.4[b]

1 A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. A nine member panel evaluated the samples.

2 For each parameter a, b, and c differ significantly ($p \leq 0.05$).

scores were still in the high range of the nine point scale. The MD salmon received the lowest scores for all four sensory parameters. It is somewhat dry in texture. Its characteristic salmon flavor may not be what panelists expect in a seafood newburg sauce. It is quite acceptable

in other dishes for which salmon is commonly used.

Table 13 shows taste panel results for sauces containing red hake, whiting, blackfish, white hake, and ocean perch. Scores for all parameters were quite acceptable. Flavor scores for the sauces

Table 13. Taste Panel Scores[1] for Frozen Seafood Newburg Sauce Prepared with Different Species of Fish, Shrimp Pieces, and Mock Crab.

| Species | Parameters | | | |
	Appearance	Texture	Flavor	Overall Desirability
Red hake	7.9[2]	7.1	7.9	7.9
Whiting	7.8	7.7	6.9	7.1
Blackfish	7.4	7.3	6.8	6.9
White hake	7.4	7.2	7.6	7.2
Ocean Perch	8.1	7.1	7.6	7.6

1 A nine point scale was used for taste panel scores, the higher numbers denoting more desirable attributes. A nine member panel evaluated the samples.

2 There were no significant differences among the scores ($p \geq 0.05$).

with whiting and blackfish were somewhat lower than the others . We felt this was because these two fish were not as fresh as the others due to technical problems getting supplies. Ordinarily, these fish should have scored higher for flavor in a product like this.

All sauces for the last two experiments (Tables 12 and 13) contained 50 grams of chopped mock crab in addition to the shrimp. The red color and different textural note the mock crab added to the sauces was well accepted by panelists.

Conclusions - Species of Fish

Cod, pollock, ocean perch, MD white pike, MD white sucker, dogfish, red hake, whiting, blackfish, and white hake were found to be quite acceptable in seafood newburg sauce. Silver hake was acceptable, but somewhat soft in texture. Surimi was acceptable, but its sweet flavor detracted somewhat from the overall flavor of the sauce. Mock crab as a replacement for all the fish would be quite acceptable if the shape of the pieces were suitable; as an addition to fish and shrimp in the sauce, it was quite attractive. Mechanically deboned salmon was acceptable in the sauce, but had texture problems (dry mouthfeel) and the flavor was different than expected. Catfish fillet flakes were unacceptable in newburg sauce because of its musty flavor. It might appeal to people in the southern regions of the United States, however.

34

RECOMMENDATIONS

Frozen Seafood Newburg

Table 14 shows the final formula for frozen seafood newburg. The procedure is:

1. Precook fish and seafood, drain, set aside.

2. Place sherry in pan, cook down to one half its volume.

3. Add butter, fish broth, and flavor bases.

4. Mix dry ingredients, slurry in part of water, add to pan. Remove from heat.

5. Small volumes of sauce: Slurry xanthan gum in oil, then add to vortex of part of water whirling in blender. Blend seven minutes. Add to pan.

   Large volumes of sauce: Follow manufacturer's instructions for addition.

6. Add red color to pan. Return to heat.

7. Cook sauce until thick, stirring constantly.

8. Blend in fish and seafood.

9. Package and freeze

Table 15 shows the approximate nutritive value of 454.0 grams (16.0 ounces) of seafood newburg sauce. It is high in good quality protein and other nutrients.

The producer of such a product would probably want to vary the kind of seafood to suit available supplies. Seafood flavoring could be added after determining which ones would be effective.

Table 14   Final   Formula   for   Frozen   Seafood   Newburg
Sauce

Ingredients	Percent
Water (or fish broth)	44.6
Cream sherry	16.9
Fish broth	13.1
Nonfat dry milk	9.8
Butter	6.1
Vee Kreme [1]	4.4
Shrimp base [2]	2.0
Modified food starch [3]	1.5
Mushroom base, if desired [4]	0.5
Roxanthin red, stock solution [5]	0.43
Vegetable oil (so slurry xanthan gum)	0.30
Xanthan gum [6]	0.20
Salt	0.09
White pepper	0.02
Cayenne	0.05

Seafood	Percent of sauce
Fish	26.20
Shrimp pieces	10.70
Mock crab, if desired	10.7

1 Fidco, White Plains, NY
2 L.J. Minor Corp., Cleveland, OH
3 Consista brand, Staley Manufacturing Co., Decatur, IL
4 Castle and Cooke, Inc., San Francisco, CA
5 Hoffman-LaRoche, Inc., Nutley, NJ
6 Keltrol brand, Kelco, Inc., Div. of Merck, San Diego, CA

Table 15   Approximate Nutritive Value[1] of Seafood Newburg Sauce Prepared with Cream Substitute and Fish, Shrimp, and Mock Crab (454 g = 16 oz)

Food energy	(cal)	648.50
Protein	(g)	37.50
Fat	(g)	34.30
Carbohydrate	(g)	32.60
Calcium	(mg)	434.90
Phosphorous	(mg)	392.20
Iron	(mg)	1.30
Sodium	(mg)	962.80
Potassium	(mg)	886.50
Vitamin A	(IU)	657.70
Thiamin	(mg)	0.18
Riboflavin	(mg)	0.72
Niacin	(mg)	1.80
Ascorbic acid	(mg)	2.18

1   Estimated from U.S.D.A. Handbook 456

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