

# IAFMM

International Association  
of Fish Meal Manufacturers

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# Fish Oil in Bakery Products

## *Project C2-89*

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RESEARCH REPORT

Submitted to:

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REFINED MENHADEN OIL IN BAKERY PRODUCTS

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## REFINED MENHADEN OIL IN BAKERY PRODUCTS

### BACKGROUND:

Fish oils are a source of fat in many countries. In the United States of America (US), the fish oil industry has not been developed and fats of marine origin have not been popular until research indicated that some fatty acids in fish oils may reduce cardiovascular disease.

In December 1987, the American Institute of Baking (AIB) was requested by Mr. Anthony Bimbo, Director of Applied Development for the Zapata Haynie Corporation in Reedville, VA, to submit a proposal for the evaluation of fish oil products in a variety of bakery foods. After two minor revisions, this proposal was accepted by Mr. Stuart Barlow, Director General of the International Association of Fish Meal Manufacturers and a sample of fish oil was submitted for evaluation.

### SUMMARY:

Five different bakery foods were prepared with refined menhaden oil added to the formula at levels ranging from 2% in white pan bread to 15% of the total flour weight in baking powder biscuits. The overall performance of this refined marine oil was similar to that of a refined soybean oil. The presence of fish oil, however, was noticeable in the white pan bread, in the baking powder biscuits, and in the yellow layer cake. It was not identified in products with a spice or a fruit added as the predominant flavor, such as cinnamon rolls or blueberry cake muffins.

## MATERIALS AND METHODS:

The sample of fish oil was received by the AIB on September 28, 1989. It was submitted by the Zapata Haynie Corporation's menhaden oil refinery and identified as SPMO<sup>TM</sup> Brand Marine Oil - Menhaden, Lot #092089-02589. The oil was shipped in small plastic bottles and it was kept frozen until it was allowed to temper overnight in the refrigerator for use in bakery products.

The performance of the SPMO<sup>TM</sup> menhaden oil (SPMO) was compared with that of a regular commercial soybean oil (SBO) in the following bakery foods:

White Pan Bread  
Cinnamon Rolls  
Baking Powder Biscuits  
Yellow Layer Cake  
Blueberry Muffins

All products were prepared under controlled conditions and evaluated for their external, internal, and eating quality characteristics within 24 hours after baking. After cooling to room temperature, the baked samples were packaged in polyethylene bread bags and stored at room temperature until their evaluation.

### 1. White Pan Bread: (Table I)

The oil was added to the dough at the rate of 2 g. oil per 100 g. flour. All pertinent information for processing the dough and for baking the loaves are included with the formulation. The loaves were proofed to an average total height of  $100 \pm 1$  mm, baked for 16 minutes at  $450^{\circ}\text{F}$  ( $225^{\circ}\text{C}$ ), and cooled for one hour at ambient temperature, before they were weighed and measured for volume by rapeseed displacement.

## 2. Cinnamon Rolls: (Table II)

The cinnamon rolls were prepared from a sweet dough. Oil was used not only in the sweet dough (8 g. oil per 100 g. flour or 194 g. dough), but it was also brushed onto the sheeted-out dough at the rate of approximately 1 g. oil per 100 g. dough (1%). After the application of the cinnamon-sugar mixture (5 g. of the mixture per 100 g. dough), the dough sheets were rolled up and sliced into 80 g. units. Nine rolls were placed into one square EKCO 664 foil pan and allowed to proof for 75 minutes before they were baked for 14 minutes at 410<sup>0</sup>F (210<sup>0</sup>C). The cinnamon rolls were evaluated on the following day for their appearance, aroma, and taste.

## 3. Baking Powder Biscuits: (Table III)

The baking powder biscuits were prepared and baked according to the instructions given with the formulation. The biscuits were evaluated on the following morning.

## 4. Yellow Layer Cakes: (Table IV)

The layer cake batters were mixed in four stages as indicated in the formula. The cakes were baked as eight inch diameter layer cakes that were evaluated after they had cooled to the ambient temperature.

## 5. Blueberry Muffins: (Table V)

Like the previously described bakery foods, the blueberry muffins were chosen because of the relatively bland cake portion in the muffin. Strongly flavored bakery foods may mask potential off-flavors introduced with any individual ingredient.

The frozen blueberries were dusted with a small portion of the flour to reduce bleeding of the fruit juice into the batter as it was processed and deposited into pans. The muffins were tasted after they had cooled to the ambient temperature and, again, on the following day.

#### RESULTS AND DISCUSSION:

##### 1. White Pan Bread: (Table VI)

There was no difference in external and internal quality characteristics of white pan bread baked with 2% (all percentages are based on the total weight of flour in the formula = 100%) refined soybean or menhaden oil. The mouthfeel of the bread was the same, too. However, the bread had a very slight fish aroma and a distinct fish taste, which may be offensive to some consumers.

##### 2. Cinnamon Rolls:

There was no apparent difference in the appearance of cinnamon rolls prepared with refined soybean oil and menhaden oil. The aroma of the cinnamon rolls made with the refined menhaden oil had a very faint off-odor that could not be identified as marine origin and the taste of both samples of cinnamon rolls was good and comparable.

##### 3. Baking Powder Biscuits: (Table VII)

Although the baking powder biscuits made with the fish oil were slightly smaller than the control biscuits prepared with soybean oil, this difference was not significant. The refined menhaden oil, however, gave the biscuits a very slightly "fishy" taste, that was objectionable to some persons, who tasted the biscuits.

#### 4. Yellow Layer Cakes: (Table VIII)

The layer cakes prepared with 12.5% SPMP oil were very similar to the soybean oil cakes in their external and internal quality characteristics. The cakes had, however a very distinct fish odor and an identifiable herring taste, which would be objectionable to any consumer.

#### 5. Blueberry Muffins:

The refined menhaden oil had no adverse effect on the physical characteristics or on the eating quality of blueberry muffins. Although the muffins had a slightly different taste, it was not identifiable as of marine origin and the muffins were considered as very acceptable to consumers.

#### CONCLUSION:

Although the menhaden oil had been refined and kept frozen until it was used for the preparation of five bakery foods, its marine origin was noticeable in three of the five products. Further stabilization of this oil is recommended before it is acceptable for general use by the baking industry. Except for its potential adverse effect on aroma and taste of bakery foods, its functionality is similar to that of refined soybean oil.

TABLE I  
WHITE PAN BREAD

Grams	Ingredients
	<u>Sponge (Preferment):</u>
700	Bread Flour
3	Mineral Yeast Food
20	Compressed Yeast
420	Water
	<u>Dough:</u>
300	Bread Flour
60	Granulated Sugar
20	Nonfat Dry Milk
20	Salt
20	Oil
190	Water and Ice (Variable)
1753	Total Dough Weight

Mixer: Hobart A-200 mixer with McDuffee bowl.

Sponge: Temperature:  $76^{\circ}\text{F}$ .  
Fermentation Time: 3.25 hours at  $84^{\circ}\text{F}$ .

Dough: Temperature:  $79^{\circ}\pm 1^{\circ}\text{F}$ .  
Fermentation (Floor) Time: 10 minutes.

Scaling Weight: 526 grams dough per loaf.

Proof: To average height of  $100\pm 1$  mm at  
 $108^{\circ}\pm 1^{\circ}\text{F}$ .

Bake: 16 minutes at  $450^{\circ}\text{F}$ .

Cooling: One hour at ambient temperature.



TABLE II  
YEAST-RAISED SWEET DOUGH

Grams	Ingredients
1000	Bread Flour
160	Granulated Sugar
80	Nonfat Milk Solids
20	Salt
80	Oil
10	Crumb Softener (Monoglycerides)
50	Compressed Yeast
2	Liquid Egg Color
540	Water (Variable)

1942 Total Dough Weight

Mixer: Hobart A-200 mixer with McDuffee bowl.

Mixing: Mix dough for 5 minutes at medium speed to "pick-up" stage or until the gluten is developed.

Dough Temperature:  $81^{\circ}\pm 1^{\circ}\text{F}$  ( $27^{\circ}\pm 0.5^{\circ}\text{C}$ ).

Fermentation (Rest) Time: 15 minutes in retarder before make-up.

Make-Up: Sheet dough to a rectangular size of 17 inch by 32 inch (43 cm by 81 cm). Brush dough surface with 20 g. oil and sprinkle 100 g. of cinnamon-sugar mixture (30g/100g) over oiled dough surface. Roll-up dough and cut into slices weighing 80g. each. Place 9 units into Ekco #664 aluminum foil pan (20cm x20cm).

Proof: 75 minutes at  $108^{\circ}\pm 1^{\circ}\text{F}$  ( $42^{\circ}\pm 0.5^{\circ}\text{C}$ ) and 85% relative humidity.

Bake: 14 minutes at  $410^{\circ}\text{F}$  ( $210^{\circ}\text{C}$ ).

TABLE III  
 BAKING POWDER BISCUITS  
 (15% Oil)

Grams	Ingredients	Mixing Method
500	1. Pastry Flour	Mixer: Hobart N-50 mixer with 5 quart bowl and pastry knife. 1. Dry-Blend Ingredients: 2 Minutes = Low Speed
30	Granulated Sugar	
50	Nonfat Dry Milk	
10	Salt	
25	Baking Powder, Double Acting	
75	Oil	
260	2. Water	2. Add water and scrape bowl. Mix: 0.5 Minute = Low Speed
950	Total Dough Weight	

MAKE-UP:

1. Flatten and roll out dough on flour-dusted surface.
2. Fold dough sheet in half and roll out to a uniform thickness of 5/8 inch.
3. Cut out biscuits with 3 inch (76.2 mm) diameter biscuit cutter.
4. Place cut-out units on cookie pan lined with silicone-treated paper.
5. Bake for 13 minutes at 420°F.

TABLE IV  
YELLOW LAYER CAKE  
(12.5% Oil)

Grams	Ingredients	Mixing Instructions
400	1. Cake Flour	Mixer: Hobart N-50 with 5 quart mixing bowl and paddle agitator. 1. Dry-Blend: 1 Minute = Low Speed
440	Granulated Sugar	
40	Nonfat Dry Milk	
60	Dried Whole Eggs	
12	Salt	
25	Baking Powder, Double Acting	
50	2. Soy Oil	2. Add Liquids and Emulsifier. Mix: 1 Minute = Low Speed 3 Minutes = Medium Speed
25	Cake Emulsifier, Kakemate	
2	Flavoring, BLV	
1	Liquid Egg Color	
200	Water	
160	3. Water	3. Add water and scrape bowl. Mix: 1 Minute = Low Speed 3 Minutes = Medium Speed
180	4. Water	4. Add and scrape bowl. Mix: 2 Minutes = Low Speed
1595	Total Batter Weight	

Scaling Weight: 400 g. batter per 8 inch diameter cake pan.

Bake: 29 minutes at 360°F.

TABLE V  
BLUEBERRY MUFFINS

Grams	Baker's %	Ingredients	Mixing Instructions	
250	50	1. Cake Flour	Mixer: Hobart N-50 mixer with bowl and paddle agitator. 1. Dry-blend ingredients: 1 Minute = Low Speed	
240	48	Bread Flour		
400	80	Granulated Sugar		
25	5	Nonfat Dry Milk		
15	3	Dried Whole Eggs		
10	2	Salt		
20	4	Baking Powder, Double Acting		
50	10	2. Soybean Oil		2. Add oil and incorporate thoroughly. 30 Seconds = Low Speed
400	80	3. Water, Cold		3. Add the water and scrape bowl. Mix: 1 Minute = Low Speed 1 Minute = Medium Speed
255	51	3. <u>Blueberry-Flour Blend</u> Wild Blueberries, Frozen		4. Dust the frozen blueberries with the flour and incorporate immediately into the batter. Mix only for about 10 to 15 seconds*.
10	2	Bread Flour		
1675	335	Total Batch Weight		

\*Scale and deposit the batter immediately into greased muffin pan.

Scaling Weight: 80 g. batter per muffin.

Bake: 25 minutes at 400°F (205°C).

TABLE VI

## BREAD EVALUATION

BREAD TYPE: White Pan Bread

Age of Bread: 1 Day (s)

EXPERIMENTAL VARIABLE: 2% Soybean Oil vs. SPMO™ Brand Menhaden Oil

## BREAD SCORES

BREAD		1	2		
QUALITIES	MAX SCORE	Soybean Oil	SPMO™ Brand Menhaden Oil		
EXTERNAL:	30				
Volume	10	9.25	9.25		
Symmetry	5	4.25	4.25		
Crust Color	10	8	8		
Break & Shred	5	4.25	4.5		
INTERNAL:	70				
Grain	10	8	8		
Texture	15	13	13		
Crumb Color	10	9	9		
Aroma	10	9	V. Sl. Fishy 8.5		
Taste	15	13	12		
Mouthfeel	10	9	9		
TOTAL SCORE	100	86.75	85.5		
Proof Height: mm		100.3	99.7		
Proof Time: minutes		65	60		
Specific Volume: cm <sup>3</sup> /g		5.26	5.29		

TABLE VII

## BISCUIT EVALUATION

BISCUIT TYPE: Baking Powder Biscuit

EXPERIMENTAL VARIABLE: Soybean Oil vs. SPMO<sup>TM</sup> Brand Menhaden OilBISCUIT SCORES

		Soybean Oil	SPMO <sup>TM</sup> Menhaden Oil		
Qualities	Max. Score				
Overall:	50				
Crumb	10	8.5	8		
Geometry	10	7.5	7.5		
Crust Color	15	12.5	12.75		
Crust Character	15	12.25	12		
Overall:	50				
Moisture	15	13	13		
Crumb Color	10	9	9		
Taste	10	9	Sl. Fishy 8.5		
Texture	15	13	13		
TOTAL SCORE	100	84.75	83.75		
Crumb pH (24 hours)					
Specific Volume: cm <sup>3</sup> /g.		2.45	2.40		

TABLE VIII  
CAKE EVALUATION

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CAKE TYPE: Yellow Layer Cake

BAKING WEIGHT: 400 g. Batter Per Cake

PAN TYPE: 8" Diameter Layer Cake

EXPERIMENTAL VARIABLE: Soybean Oil vs. SPMO™ Brand Menhaden Oil

CAKE SCORES:

Sample Number		Soybean Oil	SPMO™ Menhaden Oil			
CRITERIA	Maximum Score					
CRITERIA	30					
Volume	10	8.75	9			
Symmetry	5	4.25	4.25			
Crust Color	10	7.75	8			
Crust Character.	5	4.25	4			
REMARKS						
CRITERIA	70					
Crust	10	8	8			
Texture	15	13	13			
Crumbs Color	10	9	9			
Crustroma	10	9	Fishy 8.50			
Taste	15	13	Herring 11			
Mouthfeel	10	9	9			
Total Score	100	86	83.75			
SPIFIC VOLUME	$\frac{\text{cm}^3}{\text{g.}}$	3.96	4.04			
Sub pH (24 hours)						
Remarks						