12-1990

Effect of Using and Reusing Melt-Blown, Microwavable Materials to Heat Frozen Fish Filets: Objective and Sensory Perspectives

Patricia J. Cochrane
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To the Graduate Council:

I am submitting herewith a thesis written by Patricia J. Cochrane entitled "Effect of Using and Reusing Melt-Blown, Microwavable Materials to Heat Frozen Fish Filets: Objective and Sensory Perspectives." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Food Science and Technology.

Carol A. Costello, Major Professor

We have read this thesis and recommend its acceptance:

Betsy Haughton, Michael L. Keene

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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EFFECT OF USING AND REUSING MELT-BLOWN, MICROWAVABLE MATERIALS TO HEAT FROZEN FISH FILETS: OBJECTIVE AND SENSORY PERSPECTIVES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Patricia J. Cochrane

December 1990

ACKNOWLEDGMENTS

The author wishes to express her appreciation to the people who were instrumental in the completion of this thesis:

Dr. Carol A. Costello for her assistance, knowledge, encouragement, and most of all, her patience throughout the author's college career;

Drs. Michael L. Keene and Betsy Haughton for their assistance and understanding and for their service as committee members;

Dr. Dawn Hentges for her advice and encouragement;

Agriculture Experiment Station for financial support;

Dr. Sanjiv Malkan for sharing his knowledge of the melt-blown materials and the melt-blowing process;

Jamie Whoric for her help with and friendship throughout data collection;

Joni Pierson, Dianne Rohaus, Lisa Phillips, Leslie Halter, and Cathy Synovitz for their friendships and supplying many fond memories throughout graduate school;

Her long-time friend, Carolyn Dunn, for her support, her friendship, and the many telephone marathons;

Peter Milewski for supplying many laughs and for always taking the time to listen; and

Her parents and sister, Kelli, for their love, support, and encouragement through many stressful and doubtful times.

ABSTRACT

Frozen fish filets were heated in the microwave oven on polyester and polypropylene melt-blown materials. Paper towels were used as the control. After heating, all filets were analyzed for fat and moisture retention. Materials were stored under refrigeration temperatures (18°C) or freezing temperatures (0°C) and reused. Polypropylene melt-blown materials used once absorbed significantly more fat than polyester melt-blown materials used once. Neither absorbed more fat than paper towels. Total cooking losses, evaporative losses, and moisture retention of fish filets were not significantly different among the melt-blown materials or paper towels. Reused melt-blown materials absorbed significantly more fat than first use melt-blown materials. Total cooking losses and evaporative losses also were significantly greater for fish filets heated on reused melt-blown materials. Moisture retention for fish filets was not affected. Refrigerated melt-blown materials absorbed significantly more fat from frozen fish filets than paper towels but did not affect total cooking or evaporative losses or moisture retention of the fish filets. Frozen polypropylene melt-blown materials did not affect fat absorption or moisture retention of the fish filets but significantly increased total cooking and evaporative losses when compared to paper towels. Panelists

evaluated the fish filets after being heated on the melt-blown materials one time. Greasiness to the touch was perceived as significantly less for fish filets heated on paper towels when compared to polypropylene melt-blown materials but not polyester melt-blown materials. Mouthfeel, tenderness, moistness, and flavor were not significantly different. The results of this study indicated that refrigerated melt-blown materials exhibited greater fat absorption without increasing total cooking and evaporative losses or decreasing the moisture remaining in the heated fish filets.

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CHAPTER I

INTRODUCTION

Health has become very important to today's busy consumer (Bush, 1989; Thoms, 1985; and Sills-Levy, 1989). Consumers are more concerned with fitness and are watching what they eat (Sills-Levy, 1989). Americans are consuming more fiber, less sodium, less refined sugar, and less fat (Sills-Levy, 1989; Gorman, 1989; and Best, 1989).

Despite the push for healthier living, fat and cholesterol consumption is still high. Currently, Americans are consuming 37% of their total calories as fat, instead of the 30% recommended by the American Heart Association (1988) and the National Cancer Society (1990). Increased fat consumption is associated with coronary heart disease and certain types of cancers, particularly of the breast, colon, prostate, and endometrium (U.S. Department of Health and Human Services, 1988).

Coronary heart disease accounts for the majority (35.7%) of deaths in the United States. Cancer accounts for the next highest cause (22.4%) of deaths (U.S. Department of Health and Human Services, 1988). Obesity is linked with the incidence of both coronary heart disease and certain types of cancers. Since fat is calorie-dense, supplying over two times the calories of protein and

carbohydrate per gram, it is a wise decision to decrease fat consumption to the recommended level.

In 1988, new products introducing low- or no-cholesterol foods were up 80% compared to 1987. Low-calorie products were up 10% compared to 1987, with products sweetened with the sugar substitute Nutrasweet leading the way. Low-fat products experienced a large growth, increasing 73% from 1987 (Best, 1989). Several fat substitutes, such as Simplese, Olestra, and Trailblazer, have been developed for incorporation into processed foods (Anonymous, 1990).

Unfortunately, few kitchen aids are available to the consumer to absorb fat already present in food. Melt-blown materials are being explored as a solution to decreasing fat in foods. Melt-blown materials are a nonwoven fabric that have been used to clean up oil spills (Anonymous, 1988). Presently melt-blown materials are being explored as an alternative to paper towels in absorbing fat from food products while being heated in the microwave oven (Costello et al., 1990).

The objectives of this study were:

1. To decrease the amount of fat remaining in convenience, frozen fish filets after heating in the microwave oven;
2. To determine the effectiveness of polyester and polypropylene in absorbing fat when heating frozen

fish filets in the microwave oven;

3. To determine if reused melt-blown material can absorb additional fat after being used one time;

4. To determine if total cooking losses, evaporative losses, and moisture retained in frozen fish filets was affected by the melt-blown materials or storage of the melt-blown materials; and

5. To evaluate sensory parameters when frozen fish filets were heated in the microwave oven on melt-blown materials.

CHAPTER II

REVIEW OF LITERATURE

1. THE CHANGING AMERICAN FAMILY

The present American family is quite different from the traditional American family where the man provided the family income and the woman dealt with household chores. Presently, American men comprise 44% of all grocery shoppers (Sills-Levy, 1989). By the year 2000, an estimated 75% of American women will work outside their homes (Thoms, 1985). An estimated 54% of American families are dual-income families (Messenger, 1987).

With the advent of dual-income families, men and women have less time to spend on household matters. The average work week has increased from 41 hours in 1973 to 47 hours (Gorman, 1989). Working women spend approximately twenty minutes less time preparing meals than non-working women (Rubbright, 1986). Americans, therefore, need short cuts to prepare meals quickly without sacrificing the quality they expect. The development of microwave ovens and the subsequent development of microwavable convenience foods have helped to decrease the time spent on preparing meals.

2. THE IMPORTANCE OF MICROWAVE OVENS

The first commercial microwave oven was introduced in 1947, but it was not until the mid-1980s that the microwave oven industry began to experience some growth (Reynolds, 1989). In 1979 it was projected that 25% of Americans would own a microwave oven in 1990 (Anonymous, 1979). In 1989 more than 70% of Americans owned a microwave oven (Dornblaser, 1989), with an estimated 80-90% of Americans owning a microwave oven by the end of 1990. Currently, the microwave oven is the only kitchen appliance on the rise (Sills-Levy, 1989).

Why have microwave ovens become so popular? They save time and energy (Butler, 1987), which are advantages to today's energy- and time-conscious consumer. As the microwave oven industry grew, the microwave food industry expanded also. In 1986, 278 new microwave food products were introduced. In 1988, 1,000 new microwave food products flooded the market (Dornblaser, 1989).

3. FAT CONSUMPTION IN THE AMERICAN DIET

Americans consume a large portion of their fat in the form of meat, such as beef and pork. However, due to the concern of lowering dietary fat intake and serum cholesterol, red meat sales have declined (Gorman, 1989).

Listening to consumer demands for leaner meats, the food industry have raised animals with less subcutaneous fat (Sweeten et al., 1990). Processors also are developing meat products with less fat (McCue, 1989) and meat substitutes made from soy proteins (Best, 1989). However, there is still a considerable amount of fat in these "leaner" meats.

Fish consumption has increased in recent years because of its reputation as a low fat, low cholesterol, and high quality protein source (Thoms, 1985). Consumers perceive seafood as healthier than the red meat in their current diet (Bush, 1989). Also, fish has been shown to decrease the incidence of cardiovascular diseases. The omega-3 fatty acids have been implicated as the reason for this claim (Fletcher, 1984).

By the year 2000, fish farming is projected to increase because of the increased consumption of fish (Sills-Levy, 1989). Food processors have catered to the consumer's increasing consumption of fish. Frozen, microwavable fish dinners increased 175.3% from 1987 to 1988 (Bush, 1989).

Though fat has been implicated in many disease states, it offers unique properties that have importance to food products from a sensory standpoint. Fats, particularly solid fats such as shortening, tenderize baked products, such as cakes and pastries (Campbell et al., 1979). In addition to tenderizing baked products, air can be

incorporated into fats, which makes a baked product possess a higher volume and finer crumb (Campbell et al., 1987).

Fats also impart pleasing flavors to foods, such as the recognizable taste of fried chicken, french fries, and potato chips. Fats, particularly oils, are used as seasonings, in salad dressings, and for table use (Bennion, 1990).

It is, therefore, important to recognize that fat has important sensory characteristics and that lowering the fat in a food product should not affect the consumer's sensory perception of that food negatively.

4. THE EMERGENCE OF MELT-BLOWN MATERIAL

Background Information of Melt-Blown Materials

Melt-blown material is classified as a nonwoven fabric. Fibers are the basic structural element of nonwoven fabrics (Drelich, 1990). Unlike woven fabrics, which consist of a regular pattern of interlaced yarns, nonwoven fabrics are comprised of webs of these individual fibers arranged randomly (Mark, 1987). These individual fibers can originate from natural or synthetic sources. They are typically 12 to 15 micrometers in diameter (Drelich, 1990). Their length can range from as short as 1-3 um to any desired length (Mark, 1987). Webs are formed from these individual

fibers and then are bonded to impart strength and other physical characteristics, such as absorbency and repellancy (Drelich, 1990).

Melt-Blown Production Process

The melt-blown process is a sub-category of the spunbond technology. In this process, a bulk polymer is melted and extruded through a horizontal die containing several hundred small orifices. Streams of hot air (exiting from top and bottom sides of the die tip) attenuate the extruded polymer streams to produce extremely fine diameter fibers (1-5 um). These attenuated fibers are blown by high velocity air onto a collector screen, producing a melt-blown web (Figure 1). A combination of entanglement and cohesive sticking holds the fibers in the web together (Malkan et al., 1988).

Two polymers that are commonly used in the melt-blowing process are polypropylene and polyester. These polymers are quite different from each other.

Commercial polypropylene is generally an isotactic polymer (Frank, 1969). An isotactic polymer is defined as a polymer having unsymmetrical building blocks, in this case, the propylene group. Figures 2a and 2b illustrate the propylene group and isotactic polypropylene (Kresser, 1960).

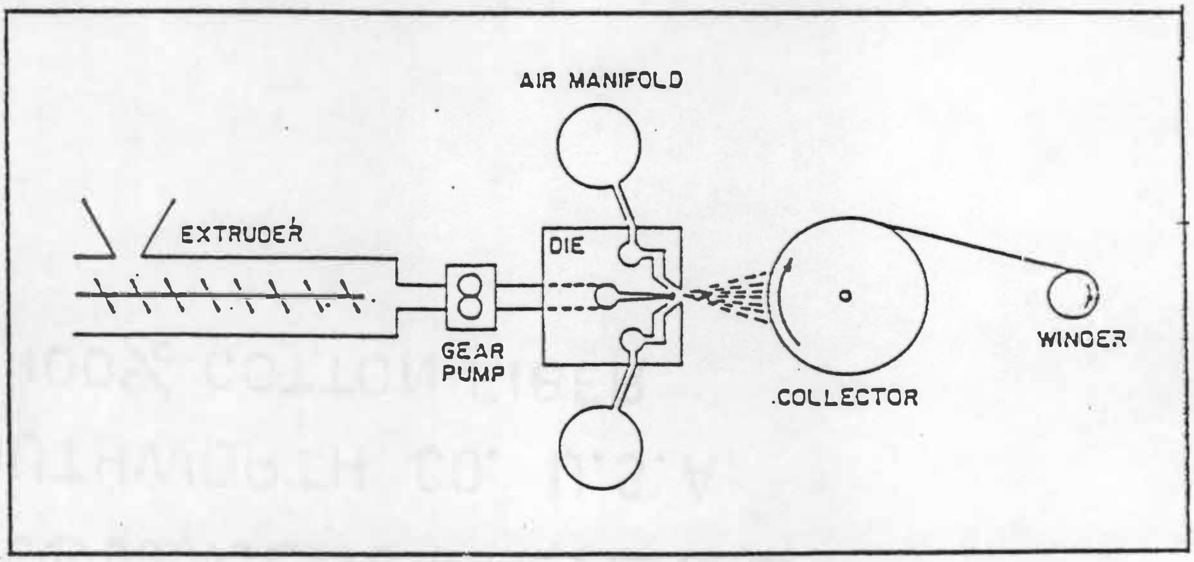
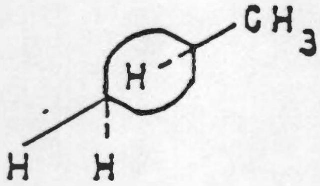
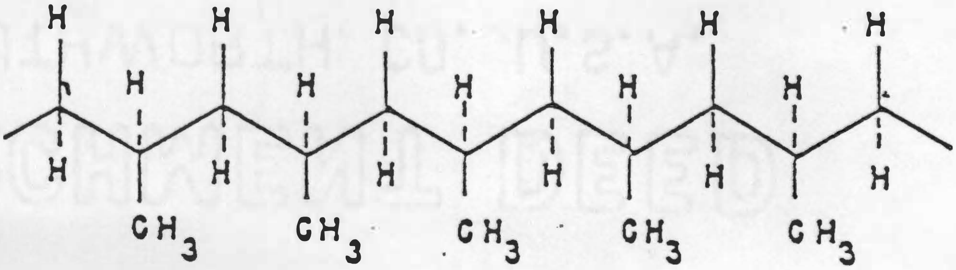


Figure 1- Melt-blown line,
The University of Tennessee, Knoxville



a



b

Figure 2- Structures of a) propylene group
b) isotactic polypropylene

An isotactic polymer will be highly crystalline, forming a regular pattern of bonds. Temperature is very important to the crystalline structure. For example, if the heated polymer is rapidly cooled, the structure will be less crystalline (Kresser, 1960).

Fibers made from polypropylene are strong, hydrophobic, and inexpensive. Polypropylene can be found in such products as syrup bottles and yogurt tubs (Douglas, 1990).

The structure of polyester (polyethylene terephthalate) is quite different from polypropylene, as can be seen in Figure 3 (Goodman, 1965). When quenched (exposed to cold water or temperatures), polyester melts become amorphous; however, crystallinity increases with temperatures 100°C up to 180°-190°C (Goodman, 1965). Hydrolysis of polyester can be a problem. The ester bonds of the polymer will disassociate in the presence of moisture and heat (Goodman, 1965).

Fibers made from polyester are strong, resilient, and expensive. Uses of polyester include cover stocks, medical disposables, tapes, and wraps (Anonymous, 1990)

Unlike polyester and polypropylene, paper towels have cellulose structure with many hydroxyl groups. Hydroxyl groups are very capable of attracting water. Figure 4 illustrates the structure of cellulose (Bennion, 1980).

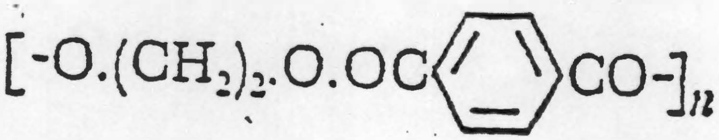


Figure 3- Structure of polyester
(polyethylene terephthalate)

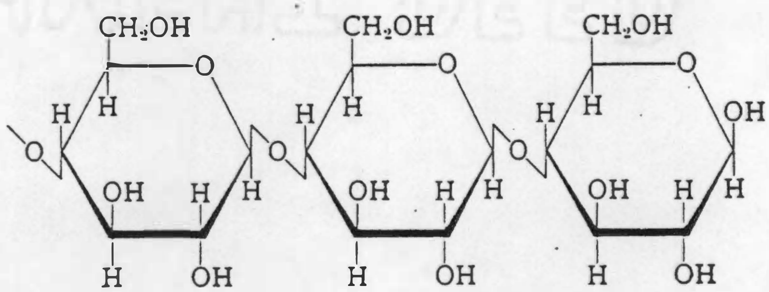


Figure 4- Structure of cellulose

Food Applications of Melt-Blown Materials

Melt-blown material is hydrophobic and will absorb fat upon contact with food (Williamson, 1990). It will not absorb water, theoretically retaining a greater amount of moisture in the food product.

Until recently melt-blown materials have been used in the food packaging and food processing industries in filter presses, vacuum filters, and belt filters (White, 1988). Currently, research is underway to determine the effectiveness of using melt-blown material to absorb fat from food products. Costello et al. (1990) determined that using the melt-blown material versus paper towels reduced fat 13.22g per 4 slices of bacon and 3.5g per sausage patty when cooked in the microwave oven. Research concerning melt-blown material and its use in the food industry must be further explored to determine its effectiveness for other food products.

CHAPTER III

MATERIALS AND METHODS

Breaded fish filets (6 cm squares) were obtained from Mrs. Paul's Kitchens, Inc. (Philadelphia, PA). Polyester and polypropylene melt-blown materials were produced at the Exxon-funded pilot plant at the University of Tennessee, Knoxville. Two pieces of 1.0 oz/sq yd of polypropylene were calendered using a pinpoint steel roller to obtain a total of 2.0 oz/sq yd. Two pieces of 1.0 oz/sq yd of polyester were calendered using a pinpoint steel roller to obtain a total of 2.0 oz/sq yd. Bounty paper towels (Cincinatti, OH) were used as a control. Both the melt-blown materials and the paper towels were cut to the size of a circular watch glass which was 15 cm in diameter.

1. COOKING PROCEDURE

The cooking procedure consisted of a heating period the first week, and a reheating period 8 days later. Figure 5 illustrates the experimental design.

Heating

During the first week, four filets were heated on

Legend:

PT= Paper Towel
PP= Polypropylene
PE= Polyester
()= Number of fish filets heated
A= Moisture and fat determined
S= Storage conditions for 8 days
R= Refrig. (18°C)
FZ= Freezer (0°C)

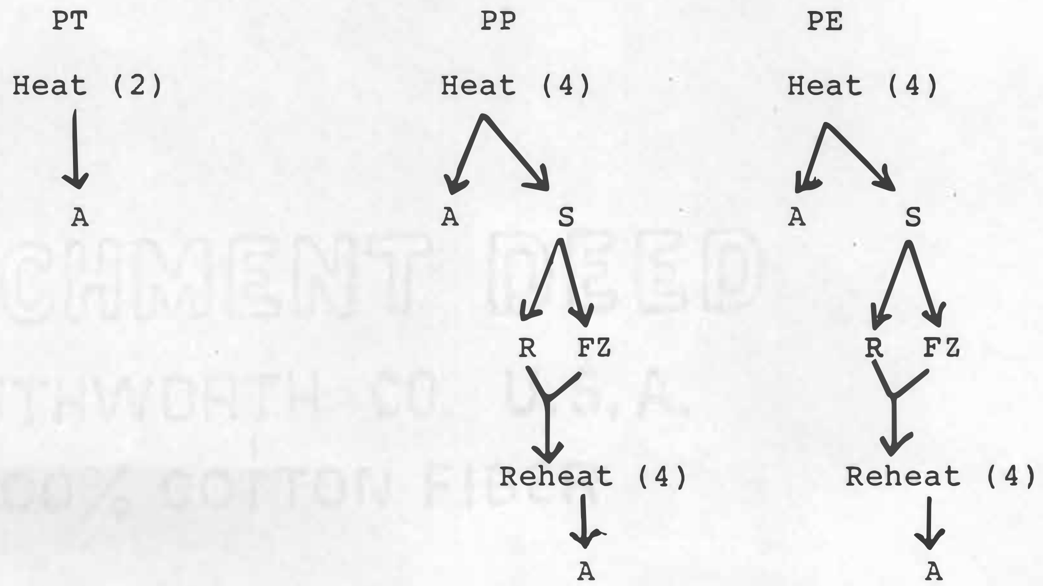


Figure 5- Schematic for experimental design.

the polyester melt-blown materials; four filets were heated on the polypropylene melt-blown materials, and two filets were heated on the paper towels. Each filet was heated separately.

The initial weight of the watch glass was recorded. Three pieces of melt-blown material or paper towels were added to the watch glass, and their combined weight was recorded. A single fish filet was added to the watch glass and the three pieces of melt-blown materials or paper towels, and their combined weights were recorded. The fish filet was placed on top of two pieces of the melt-blown material or paper towels and covered with the third piece of melt-blown material or paper towel.

The fish filet was heated in a 650-watt Sanyo microwave oven (Norcross, GA) according to manufacturer's package directions. Each filet was heated for 1 minute and 50 seconds on medium power (50%), turned ¼ turn, and heated an additional 1 minute and 50 seconds. Immediately after heating, the watch glass, melt-blown materials or paper towels, and fish filet were reweighed together. The fish filet was then taken off the watch glass with two spatulas and was weighed separately. Next, the melt-blown materials or paper towels were weighed. Lastly, the watch glass was weighed.

Storage

Immediately after weighing, the three pieces of polyester melt-blown materials from one heating period were placed in a labeled sandwich bag and then were placed in a larger plastic storage bag in the refrigerator at 18°C for 8 days. This procedure was duplicated for a total of 2 storage bags of polyester and 2 storage bags of polypropylene.

Immediately after weighing, the three pieces of polyester melt-blown materials from one heating period were placed in a labeled sandwich bag and then were placed in a larger plastic storage bag in the freezer at 0°C for 8 days. This procedure was duplicated for a total of 2 storage bags of polyester and 2 storage bags of polypropylene.

Reheating

After the melt-blown materials had been stored for 8 days in the refrigerator or freezer, they were reused. Fish filets that were heated on the frozen melt-blown materials were heated for 1 minute, rotated a $\frac{1}{4}$ turn, and heated an additional 55 seconds. Fish filets that were heated on the refrigerated melt-blown materials was heated for 1 minute, rotated a $\frac{1}{4}$ turn, and heated an additional

50 seconds.

When the melt-blown materials were reused, new fish filets were placed on the exact spot the previous fish filets occupied. The heating and weighing procedures were the same for reheating as they were for heating except for the time differences mentioned previously.

After reheating the melt-blown materials were labeled and placed in the drying oven (102-104°C) for 16-18 hours to determine moisture present in the material (AOAC, 1980). Though not mentioned, after first use, paper towels were also placed in the drying oven. Moisture present in the material was determined by subtracting the weight of the materials after drying from the weight of the materials before drying.

2. DETERMINATION OF COOKING LOSSES

After being weighed following heating, the fish filets were quartered and placed in a Black and Decker Handy Chopper (Towson, MD). The fish filets were processed for 5 seconds, checked to determine that there were no unusually large particles, and processed for an additional 5 seconds.

Two 5-gram portions from each fish filet were weighed in separate aluminum drying pans and dried in a drying oven (102-104°C) for 16-18 hours (AOAC, 1980). The cooking losses were determined by subtracting the weight of the

pan and fish after drying from the weight of the pan and fish before drying. The moisture remaining in the two 5-gram portions was averaged to obtain moisture remaining in the filet.

3. DETERMINATION OF FAT

The fat was extracted using a modified method by Bligh and Dyer (1959). Twenty-five grams of fish were placed in a blender. After adding the fish, 130 ml of methanol were added. The fish and the methanol were blended on low speed for 5 minutes. After the 5 minutes, the sides of the blender were scraped, and 65 ml of chloroform were added. Once again, the contents were blended for 5 minutes on low speed. After the five minutes, the sides of the blender were scraped, and another 65 ml of chloroform were added. The contents were blended on low speed for 20 seconds. After the twenty seconds, the sides of the blender were scraped, and 65 ml of zinc acetate were added. Contents were blended for 10 seconds on low speed.

After the 10 seconds, contents of the blender were transferred to a Buchner funnel lined with filter paper (11.0 cm) and contents were filtered After filtering, the contents of the filter, filter paper included, were transferred back to the blender, and 100 ml of chloroform were added. The contents were blended for 5 minutes.

After the 5 minutes, contents of the blender were once again filtered. Seventy-five ml of chloroform were added to the blender to rinse it. This also was filtered.

The contents of the filter flask were transferred to a 500 ml graduated cylinder. The filter flask was rinsed with 25 ml of methanol. This too was added to the graduated cylinder. The contents of the graduated cylinder were flushed with nitrogen gas, covered with plastic wrap held tight with a rubber band, and stored in a freezer at -5°C for 24 hours.

After 24 hours, total height of the solvents in the cylinder and height of the bottom layer were recorded. The contents of the graduated cylinders were transferred to 500 ml separatory funnels and stored for an additional 2 hours in the cooler.

Two 50 ml beakers for each sample were cleaned, dried in a drying oven, and cooled in a dessicator for 30 minutes. The weights of all the beakers were recorded. After the two hours, the bottom chloroform layers of the separatory funnels were drained into 500 ml flasks. Following this, two 10 ml samples of the bottom layer were transferred to the 50 ml beakers mentioned previously. Samples were allowed to sit overnight to allow the chloroform to evaporate. The following morning, beakers were reweighed, and weights were recorded.

The amount of fat per fish sample was determined using

the following equations:

lipid present = (lipid wt)($CHCl_3$ ml layer)/ 10 ml sample

percent lipid = (lipid present/gm meat started with)100

3. SENSORY EVALUATION

Ten graduate students from the Department of Nutrition and Food Sciences, The University of Tennessee, Knoxville, were trained for the sensory panel. Each student was given a set of definitions and a sample scorecard to evaluate the fish (Appendices A and B) and was taken through a mock evaluation with actual fish samples.

To aid the panelists in recognition of the anchors on the scale, various samples were prepared. The samples evaluated represented the anchors of each characteristic present on the scorecards. Characteristics evaluated were: does the sample feel greasy? tenderness, moistness, flavor, and mouthfeel. For both mouthfeel and greasiness to the touch, the anchors were 1=very greasy, which was prepared by adding a ¼ of a teaspoon of vegetable oil to a ¼ of the fish filet, and 140=not greasy, which was prepared by blotting with a paper towel. For tenderness, the anchors were 1=rubbery, which was prepared by heating the whole filet an extra minute on full power (100%), and 140=flaky,

which was prepared according to manufacturer's directions. For moistness, the anchors were 1=dry, which was prepared by heating the whole filet an extra minute on full power (100%), and 140=moist, which was prepared according to manufacturer's directions. For flavor, the anchors were 1=not acceptable and 140=very acceptable, and the filets were prepared according to manufacturer's directions.

Preparation of Fish Filets for Sensory Analysis

The fish filets were heated on three different types of materials: polyester melt-blown materials, polypropylene melt-blown materials, and paper towels. Seven fish filets were arranged in a 9'x 13'cm glass baking dish on top of two pieces of the melt-blown material or paper towels. The filets were covered with one piece of the melt-blown material or a paper towel to catch any splattering. The order in which the treatments were prepared was rotated to eliminate the variable of holding time.

The fish filets were heated for seven minutes on medium power (50%), turned a ¼ turn, and heated for an additional seven minutes on medium power. The filets were allowed to sit for two minutes before they were transferred to the chafing dishes.

Each treatment had a separate chafing dish. The chafing dishes were lined with aluminum foil and set in

a shallow stand of hot water. Sterno (Tenafly, NJ) was used to keep the water warm.

Presentation of Fish Filets for Sensory Analysis

Each fish filet was quartered. All samples were coded using random, three-digit codes. The codes were positioned randomly on the plastic plates to eliminate bias.

Each panelist received two quarters per treatment. A glass of room temperature water and two slices of apple were given to each panelist to eat between samples to cleanse the palate. The panelists were instructed to place a vertical mark on a 140 mm horizontal line to indicate the degree of each characteristic present. After panelists scored the samples, the distance the vertical line was from the left end of the horizontal line was measured. This procedure was replicated three times over two weeks. At the time of the third replication, the panelists were given a scorecard and asked to rank the samples for preference (Appendix C).

4. STATISTICAL ANALYSIS

Statistical analysis was done using Statistical Analysis System (SAS, 1982). Analysis of variance and contrast statements were utilized to determine significant

differences among the main effects. The main effects analyzed were type of material, type of storage, and reuse. Means for these effects, separately and combined, were used to determine significant differences.

CHAPTER IV

RESULTS AND DISCUSSION

Results will be divided into three sections. The first section will discuss the effectiveness of the the melt-blown materials in absorbing fat from frozen fish filets when it has been used only once at room temperature. The second section will discuss the effectiveness of the reused melt-blown materials in absorbing additional fat from frozen fish filets. Within this second section, the effect of the storage conditions on the effectiveness of reused melt-blown materials will be evaluated. The third section will discuss the sensory evaluations of frozen fish filets that have been heated on paper towels and melt-blown materials.

Before discussing the effectiveness of the melt-blown materials, it is important to note the composition of the fish filets being used (Table 1). Two fish filets contain 9g of fat, or roughly 4.5g of fat per filet. It is the presence of this fat that is important to this research.

1. EFFECTIVENESS OF MELT-BLOWN MATERIALS AFTER ONE USE

Paper towels gained significantly more weight than polypropylene but not polyester melt-blown materials (Table

Table 1- Nutritional information for Mrs. Paul's Crispy Crunchy Breaded Fish Filets

Serving size	2 filets
Servings per package	3 1/2
Calories	220
Protein	13g
Carbohydrates	23g
Fat	9g
Polyunsaturated	2g
Saturated	2g
Cholesterol	22mg
Sodium	380mg

2). It is assumed that paper towels, a cellulose-based web, will absorb both water and fat from the fish filets. The melt-blown materials only will absorb fat because of their hydrophobic nature. Total cooking losses, evaporative losses, and moisture remaining in the heated fish filets were not significantly different for paper towels and the melt-blown materials (Table 2).

Fish filets heated on polypropylene melt-blown materials retained significantly less fat than fish filets heated on the polyester melt-blown materials (Table 2). Filets heated on polypropylene melt-blown materials retained 2.66g of fat. Filets heated on polyester melt-blown materials retained 2.96g of fat. Fat retained by fish filets heated on paper towels was not significantly different from filets heated on the melt-blown materials. Filets heated on paper towels retained 2.77g of fat.

Polypropylene melt-blown fibers possess a much less dense microstructural arrangement than polyester melt-blown fibers. This has been illustrated by scanning electron micrographs and porosity measurements (Phifer, 1990). Polypropylene had potentially more spaces to fill than polyester. Due to this observation, polypropylene had the potential for greater fat absorption, which was demonstrated by chemical analysis.

Though the differences were not significant, fish filets heated on polypropylene melt-blown materials did

Table 2- Total cooking losses, percentage moisture, and fat content of fish filets heated on polypropylene, polyester, or paper towels

Parameters	Material[a] PT	PP	PE
Initial material weight, g[b]	2.49 ± .08	3.48 ± .18	3.67 ± .20
Material gain, g	1.22 r ± .27	.95 s ± .20	1.06 rs ± .16
Total cooking losses, %	11.73 r ±2.76	11.26 r ±1.51	12.36 r ±1.58
Evaporative losses, %	8.91 r ±2.43	8.91 r ±1.30	9.70 r ±1.50
Moisture remaining in heated fish filet, %	27.97 r ±4.99	26.34 r ±4.99	27.26 r ±5.65
Fat remaining in heated fish filet, g	2.77 rs ± .28	2.66 r ± .27	2.96 s ± .47
Fat remaining in heated fish filet, %	11.06 rs ±1.10	10.62 r ±1.08	11.86 s ±1.93

[a] PT=paper towel, PP=polypropylene, and PE=polyester
[b] Significance was not determined. Included only as a comparison.
[rs] Means with different letters differ at $p < 0.05$; no comparison intended among rows.

retain less fat (10.62%) than fish filets heated paper towels (11.06%) (Table 2). Since there were roughly 4.5 grams of fat present in each fish filet, perhaps the fat level was not high enough to show a significant difference between paper towels and polypropylene melt-blown materials. With respect to polyester melt-blown materials, polyester is the least effective of the three materials in absorbing fat from frozen fish filets. Evidently for first time use of the melt-blown materials, the structure of polypropylene melt-blown materials is more conducive to fat absorption than polyester melt-blown materials.

2. REUSEABILITY OF THE MELT-BLOWN MATERIALS

There is a definite difference between melt-blown materials used only once and reused melt-blown materials (Table 3). Melt-blown materials that were used only once gained significantly more weight than the reused melt-blown materials. Since the reused melt-blown materials contained the fat absorbed from the first cooking, fewer spaces were available for fat absorption on the reused melt-blown materials when compared to the melt-blown materials that were used only once.

Total cooking losses of fish filets heated on reused melt-blown materials were significantly greater than fish filets heated on melt-blown materials used only once.

Table 3- Total cooking losses, percentage moisture, and fat content of fish filets heated on polyester and polypropylene melt-blown materials that were used once and reused

Parameters	Used once	Reused
Initial material weight, g[a]	3.54 ± .19	4.35 ± .38
Material gain, g	.96 r ± .18	.66 s ± .37
Total cooking losses, %	11.62 r ±1.66	12.95 s ±2.66
Evaporative losses, %	9.17 r ±1.41	11.09 s ±2.54
Moisture remaining in heated fish filet, %	27.00 r ±5.15	25.59 r ±4.41
Fat remaining in heated fish filet, g	2.74 r ± .35	2.52 s ± .30
Fat remaining in heated fish filet, %	10.97 r ±1.43	10.07 s ±1.20

[a]Significance was not determined. Included only as a comparison.

[rs]Means with different letters differ at $p < 0.05$; no comparison intended among rows.

Evaporative losses were greater in the reused melt-blown materials and fat remaining in heated fish filets was less, thereby increasing the total cooking losses (Table 3).

As mentioned previously, evaporative losses were greater for fish filets heated on the reused melt-blown materials than for the melt-blown materials used only once (Table 3). With the addition of fat to the material and the storage temperatures (18°C and 0°C), the materials may not have conformed as readily to the shape of the fish filets, allowing greater evaporative losses into the interior of the microwave oven.

Moisture remaining in the heated fish filets was not significantly different between reused melt-blown materials and melt-blown materials that had been used only once. Moisture retention of fish filets was not affected by the reuseability of melt-blown materials.

Fat content was significantly less in fish filets heated on reused melt-blown materials than fish filets heated on melt-blown materials that were used only once (Table 3). Fish filets heated on reused melt-blown materials retained 2.52g of fat. Fish filets heated on the melt-blown materials that was used only once retained 2.74g of fat.

Temperature extremes can affect the microstructure of the melt-blown materials, particularly the crystallinity and bonding patterns (Malkan, 1990). These materials were

subjected to microwave heating, refrigeration temperatures (18°C), and freezing temperatures (0°C). A crystalline structure possesses a fixed, orderly pattern. Any disruption or irregularity, such as globules of fat, could affect the crystalline structure, thus forming a less orderly pattern, causing the structure to be more amorphous (Kresser, 1960). An amorphous structure could affect the melt-blown material's ability to absorb fat in two ways. One, an amorphous structure is less dense, allowing more fat to be absorbed because there are more spaces that can be occupied by the fat. Two, more reactive ends hydrophobic ends) could have been liberated when the crystalline structure was disrupted. In relation to the second concept, a change in bonding patterns could have affected the melt-blown material's ability to absorb fat (Malkan, 1990). A change in bonding patterns could liberate more reactive ends and absorb more fat.

It appeared from these results that the melt-blown materials are affected by the temperature extremes, but which temperature extreme had a greater effect cannot be determined from these results. To obtain a greater understanding of this phenomenon, it seems appropriate to direct the remainder of the discussion concerning reuseability toward storage temperature and melt-blown material type.

For the remainder of this thesis, room temperature

melt-blown materials used only once will be referred to as room temperature melt-blown materials. Also, reused, refrigerated melt-blown materials and reused, frozen melt-blown materials will be referred to as refrigerated and frozen melt-blown materials, respectively.

Refrigerated Melt-Blown Materials

As with the first cooking, paper towels gained significantly more weight than the refrigerated melt-blown materials (Table 4). Refrigerated polypropylene melt-blown materials gained significantly more weight than refrigerated polyester melt-blown materials, .83g and .60g, respectively. The ester bonds forming polyester are easily hydrolyzed with the addition of heat and water. The heat from the microwave oven and the moisture from the fish filets could have caused hydrolysis of the ester bonds, causing volatiles to be given off, decreasing the final weight of the polyester melt-blown materials. Since the materials were heated twice with the fish filets, hydrolysis seemed very likely. No significant differences existed for total cooking losses, evaporative losses, or moisture remaining in the heated fish filets heated on paper towels or on refrigerated melt-blown materials (Table 4).

Surprisingly, filets heated on refrigerated polypropylene and refrigerated polyester melt-blown

Table 4- Total cooking losses, percentage moisture, and fat content of fish filets heated on paper towels or refrigerated (18°C) melt blown materials

Parameters	Material[a] PT	PP	PE
Initial material weight, g[b]	2.49 ± .08	4.40 ± .31	4.32 ± .62
Material gain, g	1.22 r ± .27	.83 s ± .15	.60 t ± .57
Total cooking losses, %	11.73 r ±2.76	12.27 r ±2.90	11.02 r ±1.34
Evaporative losses, %	8.91 r ±2.43	10.08 r ±2.91	9.44 r ±1.23
Moisture remaining in heated fish filet, %	27.97 r ±4.99	26.36 r ±3.44	26.27 r ±5.28
Fat remaining in heated fish filet, g	2.77 r ± .28	2.45 s ± .33	2.46 s ± .34
Fat remaining in heated fish filet, %	11.06 r ±1.10	9.78 s ±1.32	9.83 s ±1.34

[a] PT=paper towel, PP=polypropylene, and PE=polyester

[b] Significance was not determined. Included only as a comparison.

[rst] Means with different letters differ at $p < 0.05$; no comparison intended among rows.

materials retained significantly less fat than filets heated on paper towels (Table 4). Fish filets heated on paper towels retained 2.77g of fat. Fish filets heated on refrigerated polypropylene and refrigerated polyester, retained only 2.45g and 2.46g, respectively. Fat remaining in the fish filets was not significantly different between refrigerated melt-blown materials.

From these results, melt-blown materials are positively affected by refrigeration temperatures (18°C). Fat absorption of refrigerated melt-blown materials is greater than that of paper towels, but total cooking losses and evaporative losses were not significantly affected.

Frozen Melt-Blown Materials

Similar to the results reported for the refrigerated melt-blown materials, paper towels gained significantly more weight than both the frozen melt-blown materials. Paper towels gained an average of 1.22g. Frozen polypropylene and frozen polyester gained an average of .86g and .37g, respectively. As with the refrigerated melt-blown materials, frozen polypropylene melt-blown materials gained significantly more weight than frozen melt-blown materials polyester (Table 5). This decreased weight gain could be attributed to the hydrolysis of the ester bonds in the polyester melt-blown materials mentioned

Table 5- Total cooking losses, percentage moisture, and fat content of fish filets heated on paper towels or frozen (0°C) melt-blown materials

Parameters	Material[a] PT	PP	PE
Initial material weight, g[b]	2.49 ± .08	4.29 ± .26	4.40 ± .20
Material gain, g	1.22 r ± .27	.86 s ± .15	.37 t ± .17
Total cooking losses, %	11.73 r ±2.76	15.20 s ±2.66	13.31 r ±1.66
Evaporative losses, %	8.91 r ±2.43	12.93 s ±2.67	11.91 s ±1.39
Moisture remaining in heated fish filet, %	27.97 r ±4.99	23.56 r ±5.38	26.29 r ±2.66
Fat remaining in heated fish filet, g	2.77 r ± .28	2.52 r ± .20	2.64 r ± .31
Fat remaining in heated fish filet, %	11.06 r ±1.10	10.08 r ± .81	10.57 r ±1.23

[a] PT=paper towel, PP=polypropylene, and PE=polyester

[b] Significance was not determined. Included only as a comparison.

[rst] Means with different letters differ at $p < 0.05$; no comparison intended among rows.

earlier.

The remainder of the results for frozen melt-blown materials are quite different from refrigerated melt-blown materials. Total cooking losses and evaporative losses of fish filets were significantly different for fish filets heated on frozen polypropylene melt-blown materials when compared to paper towels (Table 5). Filets heated on frozen polypropylene had greater cooking losses than filets heated on paper towels and frozen polyester. Fish filets heated on frozen polypropylene had total cooking losses of 15.20%. Total cooking losses for fish filets heated on frozen polyester and paper towels were 13.31% and 11.73%, respectively. Total cooking losses were not significantly different between fish filets heated on paper towels and filets heated on frozen polyester melt-blown materials.

Evaporative losses were significantly greater in filets heated on the frozen melt-blown materials than on paper towels. Evaporative losses of fish filets heated on frozen polypropylene and frozen polyester averaged 12.93% and 11.91%, respectively. Filets heated on paper towels averaged evaporative losses of only 8.91%. Evaporative losses were not significantly different between frozen melt-blown materials.

Due to the storage temperature (0°C), the frozen melt-blown materials may have become stiffer than refrigerated melt-blown materials. As mentioned previously,

increased stiffness would prevent the frozen melt-blown materials from conforming to the shape of the fish filet, allowing evaporative losses to escape into the interior of the microwave oven.

Moisture remaining in the heated fish filets was not significantly different between paper towels and the frozen melt-blown materials or between melt-blown materials (Table 5). Frozen melt-blown materials did not affect the moisture retention of the fish filets despite causing greater evaporative losses.

Unlike the fish filets heated on the refrigerated melt-blown materials, fish filets heated on the frozen melt-blown materials did not retain significantly less fat than those fish filets heated on paper towels (Table 5). There were no significant differences in fat remaining in fish filets whether heated on paper towels or frozen melt-blown materials or between the frozen melt-blown materials.

Two factors could have accounted for these differences in fat absorption between refrigerated and frozen melt-blown materials. One, the theorized change in crystalline structure of refrigerated melt-blown materials was more conducive to fat absorption than the frozen melt-blown materials.

Two, the heating of foods by the microwave oven could have affected fat absorption. Microwave ovens cause polar

molecules, such as water, to constantly rotate themselves. This constant rotation causes friction which creates heat (Bennion, 1990). In the case of the frozen melt-blown materials, there is no water present in the material; therefore, any heat must come from the fish and be transmitted to the fat present in the melt-blown materials. Thus, fat present in the frozen melt-blown materials would have a greater chance of staying solid during heating and occupying more space and decreasing further fat absorption. On the other hand, fat present in refrigerated melt-blown materials would have a greater chance of melting and occupying less space and increasing further fat absorption.

Polyester Melt-Blown Material

Polyester melt-blown materials that were used at room temperature gained significantly more weight than both refrigerated and frozen polyester melt-blown materials (Table 6). Room temperature polyester melt-blown materials gained 1.06g. Refrigerated polyester melt-blown materials and frozen polyester melt-blown materials gained .60g and .39g, respectively. It would appear that reheating after storing at cold temperatures caused the polyester melt-blown materials to lose weight. From this data, a relationship existed between storage temperature and material loss.

Total cooking losses of fish filets were significantly

Table 6- Total cooking losses, percentage moisture, and fat content of fish filets heated on polyester melt-blown materials stored under three storage conditions

Parameters	Storage: Room Temp.	Refrigeration (18°C)	Frozen (0°C)
Initial material weight, g[a]	3.67 ± .20	4.32 ± .62	4.40 ± .20
Material gain, g	1.06 r ± .16	.60 s ± .57	.37 t ± .17
Total cooking losses, %	12.36 rs ±1.58	11.02 r ±1.34	13.31 s ±1.66
Evaporative losses, %	9.70 r ±1.50	9.44 r ±1.23	11.91 s ±1.39
Moisture remaining in heated fish filet, %	27.26 r ±5.65	26.27 r ±5.28	26.29 r ±2.66
Fat remaining in heated fish filet, g	2.96 r ±.47	2.46 s ±.34	2.64 s ±.31
Fat remaining in heated fish filet, %	11.86 r ±1.93	9.83 s ±1.34	10.57 s ±1.23

[a] Significance was not determined. Included only as a comparison.

[rst] Means with different letters differ at $p < 0.05$; no comparison intended among rows.

greater in the frozen polyester melt-blown materials than in the refrigerated polyester melt-blown materials (Table 6). This could be attributed to a great degree to the increased evaporative losses (Table 6). Total cooking losses of fish filets were not significantly different between polyester melt-blown materials that were used at room temperature or either refrigerated or frozen polyester melt-blown materials.

Evaporative losses of fish filets were significantly greater in the frozen polyester melt-blown materials than in the refrigerated polyester melt-blown materials and the polyester melt-blown materials that were used at room temperature (Table 6). Once again, this could be attributed to the increased stiffness of the frozen melt-blown materials which would prevent conformation of the materials around the fish filets and cause the evaporative losses to escape into the interior of the microwave oven. Evaporative losses of fish filets heated on frozen polyester melt-blown materials were 13.31%. Fish filets heated on room temperature polyester melt-blown materials and heated on refrigerated polyester melt-blown materials had evaporative losses of only 9.70% and 9.44%, respectively. These materials were better able to conform to the fish filets and prevent greater evaporative losses.

Moisture remaining in the fish filets after heating was not significantly different for frozen, refrigerated,

or room temperature polyester melt-blown materials (Table 6). Temperature of the polyester melt-blown materials did not affect the moisture retention of the fish filets despite the differences in evaporative losses between refrigerated and frozen melt-blown materials.

Fish filets heated on refrigerated and frozen polyester melt-blown materials retained significantly less fat than filets heated on room temperature polyester melt-blown materials (Table 6). Fish filets heated on refrigerated and frozen polyester melt-blown materials retained 2.46g and 2.64g of fat, respectively. Fish filets heated on room temperature polyester melt-blown materials retained 2.96g of fat. There were no significant differences in fat retained in fish filets between refrigerated polyester melt-blown materials and frozen polyester melt-blown materials.

For polyester melt-blown materials, cool storage temperatures (18°C and 0°C) positively affected the microstructure of the melt-blown materials. More fat was absorbed from these materials than room temperature polyester melt-blown materials. With a change in the microstructure of polyester melt-blown materials during storage, more reactive ends could have been liberated, attracting more fat. Also, the material could have become less dense (more amorphous), which would generate more space for the fat to occupy.

From the results of this study, it is evident that for optimum results, reused, refrigerated melt-blown materials should be used for heating fish filets. Fat absorption is greater but total cooking losses and evaporative losses are not affected. Total cooking losses and evaporative losses of fish filets increased when heated on frozen polyester melt-blown materials.

Polypropylene Melt-Blown Material

Unlike the polyester melt-blown materials, material gain was not significantly different among any of the polypropylene melt-blown materials. Total cooking losses were significantly greater in fish filets heated on frozen polypropylene melt-blown materials than on refrigerated polypropylene and room temperature polypropylene melt-blown materials (Table 7). Total cooking losses were 15.20% for filets heated on frozen polypropylene. Fish filets heated on room temperature polypropylene and refrigerated polypropylene melt-blown materials had total cooking losses of 11.26% and 12.27%, respectively. No significant differences existed for filets heated on refrigerated or room temperature polypropylene melt-blown materials. As mentioned previously, frozen melt-blown materials probably do not conform as easily to the fish filets, allowing evaporative losses to escape to the interior of the

Table 7- Total cooking losses, percentage moisture, and fat content of fish filets heated on polypropylene melt-blown materials stored under three storage conditions

Parameters	Storage		
	Room Temp.	Refrigeration (18°C)	Frozen (0°C)
Initial material weight, g[a]	3.48 ± .18	4.40 ± .31	4.29 ± .26
Material gain, g	.95 r ± .20	.83 r ± .15	.86 r ± .15
Total cooking losses, %	11.26 r ±1.51	12.27 r ±2.90	15.20 s ±2.66
Evaporative losses, %	8.91r ±1.30	10.08 r ±2.91	12.93 s ±2.67
Moisture remaining in heated fish filet, %	26.34 r ±4.99	26.36 r ±3.44	23.56 r ±5.38
Fat remaining in heated fish filet, g	2.65 r ±.27	2.45 r ±.33	2.52 r ±.20
Fat remaining in heated fish filet, %	10.62 r ±1.08	9.78 r ±1.32	10.08 r ± .81

[a]Significance was not determined. Included only as a comparison.

[rs]Means with different letters differ at $p < 0.05$; no comparison intended among rows.

microwave oven, thus increasing total cooking losses.

Filets heated on frozen polypropylene had greater evaporative losses than filets heated on refrigerated and room temperature polypropylene melt-blown materials (Table 7). Evaporative losses for fish filets heated on frozen polypropylene averaged 12.93%. Fish filets heated on room temperature and refrigerated polypropylene melt-blown materials averaged 8.91% and 10.08%, respectively. No significant differences existed for filets heated on room temperature or refrigerated melt-blown materials.

Moisture remaining in the fish filets was not significantly different for filets heated on room temperature or refrigerated or frozen polypropylene melt-blown materials (Table 7). This appeared to be a contradiction since evaporative losses were greater for fish filets heated on frozen polypropylene melt-blown materials.

No significant differences existed in fat remaining in filets whether heated on refrigerated, frozen or room temperature polypropylene melt-blown materials (Table 7). The microstructure of the polypropylene melt-blown material does not appear to be affected as drastically as the microstructure of the polyester melt-blown materials.

In summary, the results for reuseability are somewhat confusing and inconclusive. However, it does appear that refrigeration temperatures (18°C) have a more beneficial

effect on the melt-blown materials. As was demonstrated, both refrigerated polypropylene and refrigerated polyester melt-blown materials absorbed significantly more fat than paper towels (Table 4).

The melt-blown materials appeared to undergo a significant change due to a difference in storage temperatures and heating. When compared to paper towels, it can be concluded that refrigeration temperatures (18°C) achieved optimum results when compared to freezing temperatures. Fish filets heated on refrigerated melt-blown materials absorbed more fat than paper towels, but total cooking and evaporative losses were not affected. Fish filets heated on frozen melt-blown materials did not absorb significantly more fat than paper towels, and evaporative losses were significantly increased for fish filets heated on both materials. Total cooking losses of fish filets also were significantly increased when heated on frozen polypropylene melt-blown materials.

Though not studied in this experiment, storage time also may have an effect on the reuseability of melt-blown materials. Decreasing or increasing storage time of the refrigerated and frozen melt-blown materials might possibly change the results found in this study.

In conclusion, refrigeration (18°C) and freezing (0°C) temperatures definitely affected the melt-blown materials. It was assumed that this change was on the

microstructural level. Unfortunately, the extent of this microstructural change, the exact nature of this microstructural change, and whether length of time of storage was a variable cannot be determined at this current time.

3. SENSORY EVALUATIONS

Filets heated on the polypropylene melt-blown materials were significantly more greasy to the touch than the fish filets heated on paper towels (Table 8). No differences existed for greasiness to the touch for fish filets heated on polyester melt-blown materials or paper towels or between melt-blown materials. It should be noted that the panelists were instructed to touch only the top of the fish filets to determine greasiness to the touch (Appendix A). The top of the fish filets came in the least contact with any of the materials. A better assessment of greasiness to the touch would have been to touch both the top and bottom of the fish filet because the materials came in greatest contact with the bottom of the fish filets.

The objective results were quite different. When determined objectively, polypropylene melt-blown materials absorbed significantly more fat than polyester melt-blown materials when both were used only once. The more fat absorption by the materials during heating, the less fat the consumer will ingest, and fat intake will be decreased.

Table 8- Mean sensory scores for fish filets heated on three different materials

Sensory Characteristics[a]	Material[b] PT	PP	PE
Greasiness	75.29 r ±31.09	55.29 s ±28.66	60.46 rs ±30.49
Tenderness	82.43 r ±30.84	76.57 r ±28.67	71.43 r ±26.94
Moistness	73.96 r ±32.60	87.82 r ±31.58	80.18 r ±29.47
Flavor	94.89 r ±26.10	95.68 r ±21.71	98.68 r ±19.62
Mouthfeel	90.64 r ±28.16	77.43 r ±24.92	78.43 r ±25.24

[a] 1=very greasy, rubbery, dry, not acceptable or very greasy; 140=not greasy, flaky, moist, very acceptable, and not greasy.
[b] PT=paper towel, PP=polypropylene, and PE=polyester.
[rs] Means with different letters at $p < 0.05$; no comparison intended among rows.

Mouthfeel was not significantly different for the fish filets heated on the melt-blown materials or for fish filets heated on paper towels. Even though panelists evaluated fish filets heated on paper towels less greasy to the touch, fish filets heated on paper towels were not evaluated as significantly less greasy when consumed. Greasy mouthfeel of the fish filets was not decreased by heating on the melt-blown materials.

No significant differences were found in moistness between filets heated on the melt-blown materials or the paper towels. This is consistent with the objective results that were found with the fish heated on paper towels and melt-blown materials used only once.

Tenderness of fish filets was not affected by the melt-blown materials. Tenderness is an important characteristic of fish. Flakiness is associated with tender fish. Dryness and firmness are associated with overcooked fish (Campbell et al., 1979).

Flavor of the fish filets also was not affected by the melt-blown materials. Flavor is a very important characteristic for all foods. If the melt-blown materials had imparted an off-flavor to the fish, the effectiveness of the melt-blown material in absorbing fat would not really be an issue. Consumers will not consume a food product if they do not find the taste appealing; no matter how healthy it may be for them.

Rank sums for fish samples heated on the melt-blown materials and paper towels were not significantly different. Rank sum for fish samples heated on paper towels was 20. Rank sums for fish samples heated on polypropylene and polyester melt-blown materials were 22 and 18, respectively. From these data, it can be concluded that there were no significant differences in acceptability among fish filets heated on paper towels, polyester and polypropylene melt-blown materials.

CHAPTER V

CONCLUSION, IMPLICATIONS, AND FUTURE RESEARCH

This study was undertaken to determine the effectiveness of polyester and polypropylene melt-blown materials in absorbing fat from frozen fish filets when compared to paper towels. Main treatment effects were material, reuseability, and storage conditions. All fish filets were heated on the melt-blown materials and paper towels in the microwave oven.

Limited studies have been performed on the effectiveness of melt-blown materials in absorbing fat from foods. Therefore, little is known about the effect of heating food on the melt-blown materials, and results presented in this paper are somewhat inconclusive.

With respect to material differences, objective measures determined that room temperature polypropylene melt-blown materials were more effective in absorbing fat from frozen fish filets than room temperature polyester melt-blown materials. However, neither room temperature polypropylene nor room temperature polyester was more effective in absorbing fat from paper towels. Total cooking and evaporative losses and moisture retention of heated fish were not significantly affected.

From the results presented in this paper, reused

melt-blown materials absorbed significantly more fat than room temperature melt-blown materials. However, total cooking and evaporative losses also were greater in the reused melt-blown materials. Temperature extremes evidently affected the microstructure of the melt-blown materials, but the exact nature of this change cannot be determined. The effect of storage time also cannot be determined from the results presented from this study.

When storage conditions were compared, refrigerated meltblown materials were optimum. Fish filets heated on refrigerated melt-blown materials retained significantly less fat than paper towels, but total cooking and evaporative losses were not affected. Moisture retention of heated fish filets was not affected by any of the main storage effects. Frozen melt-blown materials, on the other hand, did not gain significantly more fat than paper towels and caused significantly greater total cooking and evaporative losses.

Refrigerated polyester melt-blown materials absorbed significantly more fat than room temperature polyester melt-blown materials, but total cooking and evaporative losses were not affected. Frozen polyester melt-blown materials also absorbed more fat than room temperature polyester melt-blown materials but total cooking and evaporative losses also were greater.

Refrigerated polypropylene melt-blown materials were

not significantly different from room temperature polypropylene with respect to fat absorption, total cooking or evaporative losses. Frozen polypropylene, on the other hand, did not absorb more fat than room temperature polypropylene, but caused greater total cooking and evaporative losses.

After an evaluation of all the results, polypropylene meltblown materials appear to be the better material in relation to fat absorption when compared to polyester. When used at room temperature, polypropylene melt-blown materials are more effective in absorbing fat that room temperature polyester melt-blown materials. Refrigerated polypropylene also absorbs significantly more fat than paper towels. Though refrigerated polyester melt-blown materials also absorbed significantly more fat than paper towels, room temperature polyester did not.

Fish filets heated on paper towels were rated significantly less greasy to the touch than room temperature polypropylene. As previously mentioned, a better assessment of greasiness to the touch would have been to pick up the entire piece of fish filet and compare the bottom as well as the top of the fish filet instead of evaluating only the top. As with objective measurements, moistness was not affected. Tenderness, flavor, and mouthfeel also were not affected.

Implications of this study are quite exciting. Re-

frigerated melt-blown materials do absorb significantly more fat from heated fish filets than paper towels. From a health standpoint, this is promising. Individuals who need to decrease fat consumption could use the melt-blown materials to decrease their dietary fat intake, which in turn could decrease the incidence of cardiovascular disease and certain cancers. Also, since the melt-blown materials are used in the microwave oven, their potential to aid convenience is great. By aiding convenience, more individuals may use melt-blown materials, and dietary fat intake would be decreased.

There are many unanswered questions concerning the melt-blown materials; a partial list of future areas of study follows. The absorption of fat from other foods by the melt-blown materials should be investigated. In addition, the blotting ability of the melt-blown materials also should be explored for such food products as french fries and fried chicken.

Studies to evaluate the effect of temperature on melt-blown materials should also be undertaken. An optimum temperature may not be 18°C, but may lie between room temperature and freezing (0°C) temperatures. Length of storage time under different storage temperatures also should be investigated. Sensory evaluations of foods heated on the reused melt-blown materials need to be investigated. Food safety of these products also should be determined.

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APPENDICES

APPENDIX A

DEFINITIONS OF SENSORY CHARACTERISTICS

DOES THE SAMPLE FEEL GREASY?

Very greasy:	Touch sample with forefinger and slide forefinger across thumb. If fingers slide across each other easily with little friction, sample is very greasy.
Not greasy:	Touch sample with forefinger and slide forefinger across thumb. If fingers do not slide across each other easily, and there is friction, sample is not greasy.

TENDERNESS

Rubbery:	Chew sample three time. If sample is hard to masticate, and there is little detection of smaller particles, sample is rubbery.
Flaky:	Chew sample three times. If sample is easy to masticate, and there is detection of smaller particles, sample is flaky.

MOISTNESS

Dry:	Chew sample three times. If there is no detection of moisture release, sample is dry.
Moist:	Chew sample three times. If there is moisture release, sample is moist.

FLAVOR

Are there any off-flavors? Are there any offensive flavors? Is there anything unusual about the flavor?

MOUTHFEEL

Very greasy: After swallowing sample, if there is a noticeable film on the roof of the mouth or tongue, or the roof of mouth or tongue does not feel smooth, sample is greasy.

Not greasy: After swallowing sample, if there is no noticeable film on the roof of the mouth or tongue, or the roof of mouth or tongue does feel smooth, sample is not greasy.

APPENDIX B

SENSORY SCORECARD

Date:__________

Code:__________

Instructions:

Evaluate the samples for greasiness, tenderness, moistness, flavor, and mouthfeel. Place a vertical mark on the line to indicate the degree to which the characteristic is present.

Please eat a piece of apple and rinse with water between samples.

Does the sample feel greasy?

____

very greasy — not greasy

Tenderness

____

rubbery — flaky

Moistness

____

dry — moist

Flavor

____

not acceptable — very acceptable

Mouthfeel

____

very greasy — not greasy

APPENDIX C

RANKING SCORECARD

Date:__________

Code:__________

Instructions:

Rank the samples in order of overall acceptability (1=least acceptable, 3=most acceptable).

Please eat a piece of apple and rinse with water between samples.

CODE	RANK
________	________
________	________
________	________

VITA

Patricia J. Cochrane was born in Arnprior, Ontario, Canada, on March 17, 1967. She moved to Knoxville, Tennessee, when she was in the sixth grade. She graduated from Farragut High School in May 1985. She began working on her Bachelor of Science degree in Nutrition and Food Science in September of 1985 at the University of Tennessee, Knoxville, and completed her degree in May 1989. The following July she began her graduate studies in Food Science at the University of Tennessee, Knoxville. During her graduate program she served as an Agriculture Experiment Station research assistant in the Department of Nutrition and Food Science. In December 1990, she received her Master of Science degree with a major in Food Science.