To the Graduate Council:

I am submitting herewith a thesis written by Mei-Fung Chen entitled "Analysis of Selected Salads." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Food Technology.

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ANALYSIS OF SELECTED SALADS

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee

Mei-Fung Chen

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ABSTRACT

Five types of salads, cole slaw, pimento cheese, potato salad, chicken salad and ham salad from five companies, were obtained at three separate times. These were prepared, randomized and analyzed for fat, protein, fiber, ash and moisture. Methods for analysis were those recommended by the FDA for nutritional labeling.

Analysis of variance, carbohydrate and calorie values were calculated by IBM computer. Results showed that composition of salads among and within companies varied significantly. Variation among different salad types was also relatively wide.

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CHAPTER I

INTRODUCTION

Nutritionally speaking, salads are a means of supplying fiber, vitamins and minerals in the form of raw greens, raw and cooked vegetables, and fruits. The simplest green salad serves this purpose. The salad served as the main course of luncheons and suppers, and even of hot-weather dinners, is usually built around meat, fish, eggs, or cheese. It goes without saying that the portions for main dish salads are comparatively large. Their nutritional value includes more than just fiber, vitamins and minerals, supplying considerable amounts of fat, carbohydrate, and protein (15).

There are thousands of recipes for making salads in the home. Commercial salads have been developed from home-prepared foods. These salads are ready to eat and easy to obtain. A decision involving the preparation of any one salad does not necessarily have to be based upon the nutritional value of the food. In order to maintain good nutritional status and adjust the nutrient intake of the diet, nutrition labeling will be used to let housewives know how to use salads for meal planning. A listing of protein, fat, and carbohydrate in grams per serving should be made as well as listing all key nutrients.

Since the Food and Drug Administration (FDA) has published food labeling regulations and proposals in three issues of the Federal Register (12, 13, 14), prepared salads are covered by these regulations.

This means that information about composition will be needed in order for companies to know what to put on their package labels. The literature is practically devoid of such information. This project was conceived to make a limited survey of the composition of some selected salads which are currently marketed.

CHAPTER II

LITERATURE REVIEW

In former times, when people wanted to have main dish salads, housewives had to find all the ingredients in the market and use many hours to prepare them. Today the manufacture of salads is a commercial operation which can replace much work by housewives. Manufacturers use many different recipes. Because of convenience and timesaving, increasing demand has enlarged the number and size of manufacturers. For instance, in the state of Tennessee there are at least 15 food companies primarily making commercial salads as their business (10). Some examples are Mrs. Weaver's, Memphis, Lawson's Quality Salads, Inc., Knoxville, and Mrs. Kinser's, Knoxville (10). Some salad manufacturing is connected with grocery chains, such as Farm Pride brand (16). At very large grocery stores like Atlantic and Pacific Tea Company and Kroger, they make salads directly in the grocery stores in order to provide consumers very fresh salads. These are usually a part of in-store delicatessens. Also, in most cities there are numerous small delicatessens which make salads for sale.

An example of a fast-growing business in factory-made fresh salads is Gourmet Salads Company, in Ohio (2). Their sales increased tenfold in the year 1969, and they built a new building with 10,000 sq. ft. of office and manufacturing space to take care of increased demand. Potato salad was their leading item, 20,000 lbs. being produced each week.

Sales volume of commercial salads also has indicated the increasing demand for salads. Previously published data (8, 11, 21) showed that in 1954 production value of salads was $7,861,000; in 1958 it was $16,091,000; in 1963 it had increased to $25,777,000. More recent data were not available.

Although consumption of commercial salads is increasing rapidly, only sparse data exists on their nutrient value and composition. Proximate fat, carbohydrate, and mineral composition of some salads have been reported by Bowes and Church (6). The composition of four of their salads is shown in Table I. However, no data were shown on protein. High calories were related to high content of fat in salads. Fat was definitely higher in the meat-type salads, chicken ~~and~~ ham, which was reflected in their calorie content. Carbohydrate content was highest in the ham salad. Bradley's results (7), Table II, showed appreciable protein in chicken salad but very little in cole slaw and potato salad. No other data on salad composition were found in the literature.

Some data are available, however, on other types of convenience foods. Appledorf (5) analyzed hamburgers, cheeseburgers, french fries, vanilla milk shakes, and specialty items purchased from three franchise fast-food restaurants in Gainesville, Florida. From his analyses, there was little difference in the nutritional value of meals from Burger King and Burger Chef. The lower nutritional value of meals from McDonald's was primarily due to the lower mineral content. Composition of a specialty item, french fries and a vanilla milk shake from Burger King, would provide a 15 to 18 year old male with adequate calcium (46% of RDA), phosphorus (63% of RDA), zinc (49% of RDA), copper (42% of RDA),

TABLE I. COMPOSITION OF FOUR SALADS[6]

Salad	Composition				
	Carbo-hydrate	Fat	Ca	P	Calories
	%	%	mg./100 g.	mg./100 g.	per 100 g.
Cole slaw	9.4	4.2	63	60	81
Chicken salad	3.9	7.5	22	68	127
Potato salad	16.3	2.8	32	64	99
Ham salad	26.7	14.8	39	89	282

TABLE II. COMPOSITION OF THREE SALADS[7]

Salad	Composition				
	Carbo-hydrate	Protein	Fat	(Ca + P)	Calories
	%			mg./100 g.	per 100 g.
Chicken	1.2	22.2	15.6	142	234
Cole slaw	9.4	1.6	6.4	108	102
Potato	16.0	1.0	11.0	28	167

and magnesium (30% of RDA). But from McDonald's the same meal provided calcium (42% of RDA), phosphorus (45% of RDA), zinc (27% of RDA), copper (18% of RDA), and magnesium (19% of RDA). The amounts of kilocalories, protein, fat, and carbohydrate, however, were quite similar regardless of the firm.

Appledorf and Donovan (9) also analyzed franchise chicken dinners in 1973. These analyses were warranted in view of the rapid growth of this segment of the food service market, and the shift in national food habits toward more meals eaten away from home. They compared analyzed values to values calculated from USDA Handbook No. 8 by Watt and Merrill (18). Significant differences were found between analyzed and calculated values by Student's T test (17). Using a typical franchise, calculations from USDA Handbook No. 8 gave consistantly high values for protein, phosphorus, and iron, and a lower value for fat, carbohydrate, energy, and calcium than actually found by analysis. Since approximately half the calories contained in the dinners come from fat, calculated energy values would be low if calculated fat values were low. Handbook No. 8 values appear to be of limited usefulness in predicting precise proximate and mineral composition of franchise chicken dinners. The inclusion of range values, as well as, mean values in Handbook No. 8 would enhance its usefullness.

These investigations point up the well-known fact that composition of food products varies among manufacturers and among lots from the same manufacturers. Individual samples must be analyzed to get accurate data. Reliance on Handbook No. 8 values is of limited value, at best.

During the White House Conference on Food, Nutrition, and Health in December 1969 (3), the conferees felt that the present labeling of foods was inadequate, and more emphasis should be placed on increased nutrition information in labeling. The FDA has undertaken, during the past three years, a comprehensive review of food labeling; and the regulations are periodically reviewed and changed (8, 11, 21).

Nutrition information on the label follows the heading "Nutrition Information, Per Serving (Portion)" and includes: (i) serving (portion) size; (ii) servings (portions) per container; (iii) calorie content or calories expressed in 2-calorie increments up to and including 20 calories, 5-calorie increments between 20 and 50 calories, and 10-calorie increments above 50 calories; (iv) protein content or protein stated to the nearest gram; (v) carbohydrate content or carbohydrate expressed to the nearest gram; and (vi) fat content or fat expressed to the nearest gram. The amount of sodium may be declared for a food without eliciting full nutrition labeling (13).

Eight mandatory nutrients--protein, vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, and iron, in that order--must be expressed as a percentage of the U. S. Recommended Daily Allowances (U. S. RDA). When a food contains less than 2% of the U. S. RDA for five or more of the eight nutrients, a manufacturer may list either the three remaining nutrients with the less than 2% statement for the deficient nutrients or all the nutrients required by the labeling regulations but must indicate the five or more not listed in a footnote, as present at less than 2% of the U. S. RDA (12, 13).

The U. S. RDA are a set of standards derived by the National Academy of Sciences-National Research Council (1). NAS-NRC recommended RDA to replace the outmoded 1941 FDA's Minimum Daily Requirements (MDR). The latter values denoted the minimum nutrient intake necessary to prevent deficiencies or related illnesses.

The sample selected for analysis must be truly representative of the entire lot of food to be analyzed, and the portion weighed out for examination must be an accurate sample of the product available for analysis. Sample units are customarily combined to form a composite for nutrient analysis. Therefore, compliance procedures will be based on composite analyses. Such a composite must be formed from 12 consumer units chosen in a random fashion so as to be representative of the lot. The composites will be analyzed by methods of Association of Official Analytical Chemists (AOAC) where available or by appropriate analytical procedures the FDA considers reliable (12). For fat analysis, FDA developed "Interim Methodology Instructions #2." These methods will be utilized by the Division of Nutrition for regulatory analysis of samples subject to nutrition labeling covered under Code of Federal Regulations (CFR) 1.18. Currently the AOAC does not provide methods directly applicable to the requirements of CFR 1.18 (23).

CHAPTER III

MATERIALS AND METHODS

I. SOURCE OF MATERIALS

Salads were chosen from five companies which represented different types of salad manufacturers and had the same five types of salads: cole slaw, pimento cheese, potato salad, chicken salad, and ham salad. The companies chosen were coded by the letters D, F, L, M, and K.

Cole slaw and potato salad were sold in 12 oz., 14 oz., or 16 oz. plastic cartons. Pimento cheese, chicken salad and ham salad were obtained in 7 oz. or 8 oz. cartons. Portions of salads from companies D and K were weighed into plain, unlabeled plastic cartons at the point of sale. Samples were obtained in retail groceries or at the manufacturing plant.

A list of ingredients was made when salads were bought. Salads were picked up at three different times.

II. PREPARATION OF SAMPLES

All samples were coded to identify different samples after they were prepared for analysis. Roman numerals were used for analysis, Arabic numerals for type of salad, alphabetical capital letters for companies, lower case letters for times, and lower case Roman numerals for replicates. A coded example would be: III 2 C a i--the first replicate for protein analysis of pimento cheese from the third company collected the first time.

Salads were weighed on a top-loading balance, $\pm$ 0.01 g., and homogenized in a Waring Blendor for two minutes with an amount of distilled water to get an acceptable consistency for pipetting. After homogenizing, samples of each salad were separated and put into five different coded Whirl-Pak bags (NASCO; 6 oz.) and frozen at -18°C. All samples were held frozen until analyzed. Preliminary work showed that moisture loss through the bags was negligible.

III. METHODS OF ANALYSIS

Samples were grouped first according to the analysis to be performed--fat, protein, ash, fiber, or moisture. For any one analysis, such as fat, there were 45 total samples; 5 companies purchased at 3 times, and subdivided to provide 3 replicates of the 15 treatments.

Moisture Determination

Moisture content was determined by the vacuum drying method, AOAC 14.122 (4). Two g. of sample were dried to constant weight at 60°C. in a Vacuum Oven (Precision Scientific Co., Chicago, Illinois). Results were expressed as percentage of moisture calculated from weight loss.

Ash Determination

Ash content was determined by dry ashing the sample at 550°C., AOAC 14.006 (4). Two g. of samples were ashed at 550°C. for four hours, and % ash was determined by weight loss.

Protein Determination

Total nitrogen was determined by the Kjeldahl method, AOAC 2.051 (4).

For salads with higher protein content, such as pimento cheese, chicken salad, and ham salad, about 4 g. of sample were weighed in a Kjeldahl flask. One Kel-Pak (Matheson, Kel-Pak Powder No.1P, 9.9 g. K_2SO_4, 0.41 g. HgO, 0.08 g. $CuSO_4$ and 0.099 g. pumice) and 25 ml. concentrated H_2SO_4 were added, the flask was placed on the Kjeldahl digestion rack, heated on low heat until frothing had ceased, then the heat was increased to boil briskly for 30 min. after the solution cleared. Flasks were removed, cooled, and 200 ml. cold distilled water was added and mixed thoroughly. Fifty ml. of 50% NaOH solution and 25 ml. of 8% $Na_2S_2O_3$ mixture was added along with a few Zn granules to the digestion flask, layering the base beneath the acid mixture. Fifty ml. of 4% Boric acid solution was measured into a 500 ml. Erlenmeyer and placed under the condenser. One hundred-fifty ml. of solution was distilled into the receiver containing 4% Boric acid. Five drops of methyl red indicator were added and the solutions were titrated with 0.1096N HCl.

Calculation:

$$\% \text{ N} = \frac{\text{ml. HCl x N HCl x 0.014 x 100}}{\text{g. of sample}}$$

$$\% \text{ Protein} = \% \text{ N x 6.38}$$

A reagent bland containing 2 g. reagent grade sucrose instead of sample was run each day. The blank titration was subtracted from the volume before calculation.

For low protein content salads, such as cole slaw and potato salad, about 15 g. of sample were weighed in the flask and dried in an air oven (Precision Scientific Co., Chicago, Illinois) for 30 min. at 100°C. The procedure was the same as described before, except 50 ml. concentrated H_2SO_4 and 125 ml. of 50% NaOH solution instead of 25 ml. and 50 ml. were used.

Fat Determination

Fat was determined by FDA Interim Methodology Instruction No. 2, June 11, 1974 (23). Homogenized samples were weighed into 300 ml. Erlenmeyer flasks. Sample size was set to contain about 1 g. of fat. For every 5 g. of sample, 40 ml. of 4N HCl was added. Samples were digested 30 min. at 60°C., and then 30 min. at 90°C. in a water bath. After it was cooled to room temperature, the digestion mixture was transferred to a 500 ml. separatory funnel, and the flask was rinsed with ethyl ether thoroughly. Three 35 ml. aliquots of ethyl ether were used to extract the fat, and the extracts were combined in a beaker. Whatman #4 paper with 2 g. anhydrous Na_2SO_4 was used to filter extracts. Ether extracts were transferred to tared 150 ml. beakers and the ether was evaporated on a steam table under a hood. Beakers containing fat were dried in the vacuum oven at 60°C. for 30 min., and transferred to a dessicator, cooled, weighed, and the percentage of fat was calculated from the weights of sample and fat.

Crude Fiber Determination

Crude fiber was determined by AOAC 7.053-7.057 (4). About 2 g. of sample were weighed in an aluminum pan and dried at 60°C. in the vacuum oven. One g. of asbestos was weighed into a Gooch crucible and packed down with a spatula. The dried sample was broken up into fairly fine grains and placed on top of the asbestos in the Gooch crucible. Three 10 ml. portions of ethyl ether were used to extract fat. Sample and asbestos were then transferred into a fiber digestion beaker containing 200 ml. boiling 1.25% H_2SO_4, digested exactly 30 min., and then filtered through a Gooch crucible containing 0.1 g. asbestos. After all the solution had been filtered, 50-75 ml. boiling water and 3, 50 ml. portions of water were used to rinse the beaker, washed through the Gooch crucible and sucked dry. The mat and residue were removed to the fiber beaker containing 200 ml. boiling 1.25% NaOH and boiled exactly 30 min. The solution was filtered and washed with 25 ml. 95% ethanol. The Gooch crucible was dried to constant weight at 130°C. for 2 hrs., cooled in a dessicator, and weighed. After the Gooch crucible had been weighed, it was ignited 30 min. at 600°C. in a muffle furnace, cooled in a dessicator, and weighed. The loss of weight on ignition, which is weight of crude fiber, was calculated.

Carbohydrate Determination

Carbohydrate content was obtained by difference:

$$100 - ((\%\ \text{Moisture}) + (\%\ \text{Ash}) + (\%\ \text{Fat}) + (\%\ \text{Protein}) + (\%\ \text{Crude fiber})) = \%\ \text{Carbohydrate}$$

Calorie Determination

Calories were calculated by Atwater factors, multiplying g. of protein and available carbohydrate by 4 Kcal./ g. and g. of fat by 9 Kcal./g. (18).

IV. STATISTICAL ANALYSIS

Data were subjected to analysis of variance by a factorial arrangement of treatments in a randomized complete block design with 3 replications. ANOVA, tests, and means were calculated by the SAS program (22) using the University of Tennessee IBM computer. Comparisons among means from treatments indicated as significant at the 5% level of probability were made by the Student-Newman-Keuls' test (24).

CHAPTER IV

RESULTS AND DISCUSSION

There were several objectives in this work. First, the proximate composition of five types of salad was to be determined: cole slaw, pimento cheese, potato salad, chicken salad, and ham salad. The same salads from different companies were expected to vary in composition, so five separate companies were chosen. Manufacturing operations can vary from one time to another, so samples were obtained from the various companies at three different times.

No effort was made to standardize the time between sample pickups, but times were wide enough apart to insure that different batches were obtained. Time between sample pickups averaged about one month. Preliminary work showed that moisture loss through Whirl-Pak bags was negligible for frozen samples, so samples were blended and stored in a deep freeze until all samples were collected. This made it possible to randomize replicate samples for the several analyses: fat, protein, fiber, ash, and moisture.

Several sources of variation in composition of prepared foods such as salads can be postulated. Salads are prepared from recipes; and over time, a company could change the recipe that it uses for a certain salad. One would expect such a change to make a relatively large change in composition. Also, one would expect different companies to use different recipes for the salad, giving rise to variation among companies.

Errors in measuring ingredients, either in weight or volume, could also cause variation in composition. One might expect this type of error to cause smaller variations than a recipe change, unless a gross error were made. Another source of variation in composition could be from inadequate mixing. Observations at the time of obtaining samples showed that delicatessens often held salads for several days in uncovered containers in refrigerated cabinets. Moisture loss or gain under such conditions would cause composition to vary. Finally, variations in the composition of ingredients used could also cause variations in the composition of the salads.

Variations in composition will be presented and discussed by type of salad. Tabular data will show composition means, first among the five companies and then within companies across time. Although calories are a result of, rather than part of, composition, the calculated calorie means will be presented with the composition data for purposes of comparison. In the analyses of variance of the composition data, replication effects were not significant at the 5% level of probability, except for ash in ham salad, which was significant at 5%, but not at 1%. For most of the data, the effect of time was significant, but it was felt that time effects separated from company were not pertinent, so time means are not presented. Analyses of variance were calculated and obtained from the University IBM computer. A typical analysis of variance, such as for variable fat of pimento cheese, is given in Table III.

Analytical error in the experimental work can be measured by the coefficient of variation (c.v.) for a particular analysis. These are listed for the analyses performed on the five types of salad in Table IV.

TABLE III. ANALYSIS OF VARIANCE FOR FAT OF PIMENTO CHEESE

Source	DF	Sum of Squares	Mean Square	F Value
Company	4	6798.52556	1699.63139	724.74349*
Time	2	22.71792	11.35896	4.84360*
Company x Time	8	55.37141	6.92143	2.95138*
Replication	2	2.84230	1.42115	0.606
Residual	28	65.66417	2.34515	
Corrected total	44	6945.12136	157.84367	

*Significant at the 5% level of probability.

TABLE IV. COEFFICIENTS OF VARIATION FOR ANALYSES ON FIVE TYPES OF SALAD

Salad	Analysis				
	Fat	Protein	Fiber	Ash	Moisture
	c.v., %[a]				
Cole slaw	9.01	9.76	4.05	17.87	1.18
Pimento cheese	5.58	2.61	5.48	4.58	3.27
Potato salad	4.78	3.49	6.46	14.03	2.05
Chicken salad	2.42	3.16	5.69	14.06	2.45
Ham salad	4.34	3.26	6.75	13.91	3.47
Means	5.23	4.46	5.69	12.89	2.48

$$^{a}\text{c.v., \%} = \frac{\text{standard deviation}}{\text{mean}} \times 100$$

The coefficient of variation as a percent is expressed by the equation:

$$\text{c.v.} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

Moisture had the lowest c.v., and ash had the highest. The other three analyses had about the same degree of error. Errors are caused by variations in technique, and the degree of error increases with the number of steps in the operation. The more steps in analysis, the larger the error would be. In fat analysis, error could be due to weighing, transferring, extracting, and evaporating ether. Weighings and titrations introduce deviations in protein values. The digestion in fiber analysis may have introduced error because of filtering and transferring samples. Ignition and transferring sample could explain the largest error in analysis of ash. Also, the weights involved in ash determinations are very small, and so small errors in weighing would cause relatively larger percentage errors in results.

The composition of cole slaw from the five companies is shown in Table V. Fat content was significantly different among companies. Brand D cole slaw had the highest amount of fat, and Brand M had the lowest. The highest value was almost three and one-half times the lowest one. The percentages of protein are all relatively low in cole slaw. This could be anticipated since the major ingredients are cabbage and mayonnaise and all slaws had a high moisture content. The differences in protein data among the companies, even though significant, were not very wide. The fiber content also varied significantly. Brand K salad had about three times more than Brand L which had the lowest fiber content. Brands D and L had lower ash content than the overall mean of ash.

TABLE V. COMPOSITION MEANS OF COMPANIES FOR COLE SLAW

Company	Means[1,2]						
	Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
	%	%	%	%	%	%	Per 100 g.
D	18.73a	1.34a	2.44a	0.88a	68.58a	8.04a	206.05a
F	16.72b	1.36a	1.67b	1.08b	69.85b	9.33a	193.19b
K	10.97c	1.12b	3.14c	1.37c	68.39a	15.00ab	163.22c
L	6.90d	1.00b	1.08d	0.78a	77.76c	12.48c	116.06d
M	5.26e	1.12b	1.74b	1.23bc	78.87d	11.79c	98.97e
Overall Means	11.71	1.19	2.01	1.07	72.69	11.33	155.50

[1]Means within column groups of five followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of nine observations.

Moisture contents of all samples were relatively high in cole slaw compared to the other salads. Moisture made up almost 70% of the total weight. Brand D had the lowest carbohydrate content, which was about half of the highest one, Brand K. Without doubt, Brand D had the highest value of calories because of its high fat content, and M had the lowest calorie value because it had the lowest content of fat.

The composition means of company - time interactions for cole slaw are shown in Table VI. Brand D cole slaw did not change in its composition of protein, ash, and carbohydrate over the three different times, but the amount of fat was twice as high the first time as the last two. A change in the recipe, such as, using half the volume of mayonnaise in cole slaw, or changing to salad dressing could be responsible for the difference. However, other variables previously mentioned could likewise play a part in these differences. The calorie value changed because of fat content. The composition of cole slaw from Company F had little variation except fat and carbohydrate content. Especially at the second pickup time, the carbohydrate content was comparatively low. This might have come from errors in weighing ingredients or changing recipes. The data showed that the other three companies all might have changed their recipes once. The third time for Company K salad had a lower content of fat and protein, and had a relatively high moisture content. From those data, variation of composition could be changed by adding different amounts of mayonnaise. The variation of fat among the three times shows that composition of cole slaw was not uniform for any of the five companies.

Pimento cheese is made primarily out of cheddar cheese, cheddar-

TABLE VI. COMPOSITION MEANS OF COMPANY-TIME INTERACTIONS FOR COLE SLAW

Company	Time	Means[1,2]						
		Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
		%						Per 100 g.
D	1	28.06a	1.33a	2.53a	0.79a	59.77a	7.52a	287.91a
	2	13.70b	1.30a	2.60a	0.98a	72.03b	9.40a	166.06b
	3	14.42b	1.39a	2.19b	0.86a	73.94c	7.21a	164.18b
F	1	14.45a	1.24a	1.76a	0.90a	71.18a	10.47a	176.87a
	2	19.08b	1.27a	1.76a	1.03a	72.98b	3.88b	192.29b
	3	16.62c	1.58b	1.49b	1.30a	65.39c	13.62c	210.41c
K	1	12.90a	1.22a	2.90a	1.34a	66.29a	15.34a	182.40a
	2	14.52a	1.32a	3.37b	1.57a	66.70a	12.52b	186.04a
	3	5.48b	0.82b	3.16c	1.22a	72.17b	17.15a	121.22b
L	1	8.96a	0.95a	0.91a	0.64a	75.82a	12.73a	135.36a
	2	4.64b	1.08a	1.15b	0.89a	79.76b	12.48a	95.98b
	3	7.11c	0.98a	1.17b	0.81a	77.69c	12.24a	116.84c
M	1	5.97a	1.15a	2.13a	1.27a	78.27a	11.21a	103.15a
	2	6.39a	1.18a	1.75b	1.35a	76.74b	12.59a	112.61a
	3	3.42b	1.01a	1.34c	1.05a	81.61c	11.57a	81.14b
Overall Means		11.71	1.19	2.01	1.07	72.69	11.33	155.50

[1]Means within column groups of 3 followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of three observations.

type cheese, or cheese food which provides appreciable protein and fat. Pimento cheese from all companies had relatively high percentages of protein and fat and narrow variations in protein content. Composition of pimento cheese from the five companies is shown in Table VII. The wide variation in fat may be reflected in the moisture content. However, other variables such as amounts of dressing, types of cheese products and possible changes in the recipe could be responsible for the wide variations. It might also cause the variation in the relative amounts of carbohydrate. Variations in moisture may be due to added water. Variation in fiber content could be assumed to come from different amounts of pimento that were added to pimento cheese. Pimento is the only ingredient contributing fiber which was the reason for the low fiber content. Table VII shows that Brand D pimento cheese had the highest fat content, more than three times the lowest one, Brand M, and had the lowest content of moisture and carbohydrate. As to the M pimento cheese, it had the lowest fat content, the highest content of moisture, and the second high content of carbohydrate. Calorie values from the five companies had wide variation. The highest calorie value of pimento cheese, which was D, was about two times of the lowest one, Brand M.

The composition of company - time interactions for pimento cheese is shown in Table VIII. Variation in composition means in general at three different times were relatively small for pimento cheese, except for Brand L. From Table VIII the protein and fat content of Brand L at the third time was higher than the first two pickup times. This could have been caused by changing recipe such as adding some more cheese, but not just adding dressing only. Even though variations were considered

TABLE VII. COMPOSITION MEANS OF COMPANIES FOR PIMENTO CHEESE

Company	Means[1,2]						
	Fat	Pro-tein	Fiber	Ash	Mois-ture	Carbo-hydrate	Calories
	%						Per 100 g.
D	47.80a	9.82a	0.76a	3.64a	28.10a	9.88a	509.02a
F	35.10b	11.26b	0.52b	2.99b	36.70b	13.43b	414.67b
K	21.78c	8.77c	0.47c	3.83c	50.92cd	14.23b	288.02c
L	17.55d	9.07d	0.41d	3.25d	50.00d	19.72c	273.14d
M	15.10e	8.73c	0.50e	3.92c	52.11c	19.63c	249.35e
Overall Means	27.47	9.53	0.53	3.53	43.57	15.38	346.84

[1]Means within column groups of five followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of nine observations.

TABLE VIII. COMPOSITION MEANS OF COMPANY-TIME INTERACTIONS FOR PIMENTO CHEESE

Company	Time	Means[1,2]						
		Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
		%						Per 100 g.
D	1	45.16a	9.52a	0.84a	3.39a	31.73a	9.36a	482.00a
	2	48.91b	9.95b	0.77b	3.56a	26.54b	10.28a	521.07b
	3	49.34b	9.99b	0.67c	3.97b	26.03b	10.00a	524.00b
F	1	34.90ab	11.53a	0.55a	2.72a	36.88a	13.42a	413.92a
	2	37.30b	10.83b	0.49b	3.02b	34.30b	14.33a	433.90b
	3	33.37a	11.44a	0.51ab	3.24b	38.91a	12.54a	396.19c
K	1	20.98a	8.85ab	0.43a	3.67a	51.09ab	14.99a	284.12a
	2	21.99a	9.20a	0.44a	3.92a	49.03a	15.60a	296.40a
	3	22.38a	8.44b	0.53b	3.91a	52.65b	12.09a	283.52a
L	1	15.83a	8.18a	0.45a	2.93a	49.89a	22.72a	266.05a
	2	17.56ab	8.98b	0.36b	3.52b	49.90a	19.67a	272.64a
	3	19.27b	10.04c	0.42a	3.30b	50.19a	16.78a	280.73a
M	1	15.45a	9.12a	0.52a	4.16a	50.26a	20.49a	257.51a
	2	14.04a	8.61b	0.49a	3.75b	52.97a	20.14a	241.36a
	3	15.80a	8.48b	0.49a	3.85b	53.11a	18.27a	249.17a
Overall Means		24.47	9.53	0.53	3.53	43.57	15.38	346.84

[1]Means within column groups of 3 followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of three observations.

"relatively small," the data show significant variations over time for several constituents. Such variation could be a reflection of poor operational control.

Potatoes provide mostly carbohydrate and ash. The composition of potato salad from the five companies is shown in Table IX. Due to different recipes, there were very wide variations among companies on all of the composition factors except moisture. Company D had the highest content of fat and the lowest content of ash and carbohydrate. Brand K gave the highest value of ash and carbohydrate and the second lowest value of fat. This could be primarily due to the different amount of mayonnaise or salad dressing being added. Brand F potato salad had the highest protein content. The order of calorie values also follows the order of fat content. Potato salad from all companies contained the second high moisture content which was lower than that of cole slaw, and it had the highest carbohydrate content in these five kinds of salad.

Table X shows the composition means of company - time interactions for potato salad. From the wide variation among three different times within each company one could assume that they changed recipes or dressing type. The salad which was the second pickup from Company D may have changed the composition by changing recipes. The fat content of this sample was about one fourth of that of the first pickup. Brand F might have added some more mayonnaise to increase fat content at the second time and might have used more vinegar instead of mayonnaise at the third time. This could be reflected by changing content of moisture. Variations in Brands K and L were not very wide. It could be postulated that errors in measuring happened or operators were changed. Brand M might

TABLE IX. COMPOSITION MEANS OF COMPANIES FOR POTATO SALAD

Company	Means[1,2]						
	Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
	%						Per 100 g.
D	14.64a	1.79a	1.05a	0.79a	68.36ab	13.36a	192.36a
F	9.11b	1.89b	0.82b	1.06b	69.87b	17.25b	158.57b
K	6.62c	1.62c	0.84b	1.93c	67.76a	21.23c	150.98c
L	6.55c	1.18d	0.63c	1.40d	69.53b	20.72cd	146.53c
M	9.98d	1.68e	0.90d	1.27d	66.97a	19.19d	173.36d
Overall Means	9.38	1.63	0.85	1.29	68.50	18.35	164.36

[1]Means within column groups of five followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of nine observations.

TABLE X. COMPOSITION MEANS OF COMPANY-TIME INTERACTIONS FOR POTATO SALAD

Company	Time	Means[1,2] Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
		%						Per 100 g.
D	1	20.76a	2.28a	0.61a	0.55a	61.54a	14.26a	253.03a
	2	4.91b	1.49b	1.09b	0.70a	80.48b	11.33a	95.50b
	3	18.24c	1.62c	1.46c	1.13b	63.07a	14.49a	228.54c
F	1	4.95a	1.45a	1.00a	0.85a	71.02a	20.73a	133.30a
	2	12.36b	2.36b	0.76b	1.34b	67.92b	15.26b	181.72b
	3	10.02c	1.87c	0.68b	1.00a	70.67a	15.76b	160.70c
K	1	5.93a	1.63a	0.88a	1.91a	69.60a	20.06a	140.12a
	2	7.76b	1.62a	0.93a	1.98a	66.04b	21.68a	163.03b
	3	6.17a	1.62a	0.71b	1.91a	67.64ab	21.96a	149.81c
L	1	7.82a	1.33a	0.43a	1.59a	66.33a	22.49a	165.70a
	2	6.44b	1.00b	0.65b	1.38ab	71.40b	19.12b	138.48b
	3	5.37c	1.20c	0.80c	1.22b	70.85b	20.56ab	135.40b
M	1	10.64a	1.96a	1.06a	1.32a	69.96a	15.05a	163.83a
	2	8.76b	1.53b	0.80b	1.25a	69.48a	18.18b	157.65a
	3	10.56a	1.56b	0.83b	1.24a	61.48b	24.34c	198.61b
Overall Means		9.38	1.63	0.85	1.29	68.50	18.35	164.36

[1]Means within column groups of 3 followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of three observations.

have changed recipe at the second time, then just added some more mayonnaise at the third time. As to variation in calorie value, most samples changed as the fat content changed in potato salad.

Chicken salad is a main dish meat salad. It had the second highest fat, protein and calorie value which were lower than those of pimento cheese. The composition means among companies for chicken salad is shown in Table XI. There were relatively wide variations in composition of fat, protein and moisture. Brand D had the highest value of fat which could come from mayonnaise or chicken fat. Owing to having the lowest protein content, it could be assumed that the chicken contained a relatively high percentage of fat in Brand D chicken salad. Brank F chicken salad had the highest protein content and the lowest carbohydrate content. Brand K had the second lowest fat content which was about half of that of the highest one, and contained the highest content of ash. Brand L had the highest moisture value and the lowest fat content. Three of the chicken salads, D, M, and F, had almost identical calorie contents with the remaining two lower.

The composition means of company - time interactions for chicken salad are shown in Table XII. Even though there were significant differences among fat values of chicken salads from companies D and F, there was not much variation. One could postulate that errors in weighing or differences in chicken composition or other variables caused the differences. Chicken salads K and M had relatively wide variations in fat and protein contents. These could be caused from different sources of ingredients or changing recipes. Some chicken is very lean, and some is not. Brand L gave relatively low variations in composition, except for

TABLE XI. COMPOSITION MEANS OF COMPANIES FOR CHICKEN SALAD

Company	Means[1,2]						
	Fat	Pro-tein	Fiber	Ash	Mois-ture	Carbo-hydrate	Calories
	&						Per 100 g.
D	31.94a	6.15a	0.91a	1.31a	48.99a	10.70ab	354.86a
F	29.10b	13.44b	0.80b	1.48a	45.62b	9.56a	353.93a
K	14.75c	11.23c	0.67c	1.96b	59.92c	11.47b	223.58b
L	13.15d	7.10d	0.87a	1.40a	63.81d	13.67c	201.42c
M	30.84e	6.64e	0.91a	1.71c	47.51e	12.40bc	353.72a
Overall Means	23.96	8.91	0.83	1.57	53.17	11.56	297.50

[1]Means within column groups of five followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of nine observations.

TABLE XII. COMPOSITION MEANS OF COMPANY-TIME INTERACTIONS FOR CHICKEN SALAD

Company	Time	Means[1,2]						
		Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
		%						Per 100 g.
D	1	32.08ab	5.99a	1.13a	1.00a	48.89a	10.90ab	356.34a
	2	31.27a	6.07a	0.79b	1.48b	47.95a	12.43a	355.49a
	3	32.46b	6.39a	0.82b	1.45b	50.12a	8.77b	352.75a
F	1	30.43a	12.82a	0.93a	1.91a	45.06a	8.85a	360.55a
	2	28.37b	14.88b	0.65b	1.19b	45.96a	8.96a	350.66a
	3	28.50b	12.63a	0.81c	1.35b	45.83a	10.88a	350.57a
K	1	19.05a	13.63a	0.65a	2.08a	54.12a	10.47a	267.85a
	2	13.93b	9.30b	0.74b	1.86a	62.11b	12.05a	210.83b
	3	11.28c	10.75c	0.62a	1.94a	63.53b	11.89a	192.07c
L	1	12.55a	7.40a	0.98a	0.84a	63.03a	15.21a	203.39a
	2	15.01b	7.58a	0.79b	1.54b	63.34a	11.73b	212.39a
	3	11.88a	6.33b	0.85b	1.81b	65.06a	14.07ab	188.49b
M	1	32.52a	6.04a	0.81a	1.83a	47.38a	11.41a	362.52a
	2	29.11b	5.95a	0.82a	1.57a	47.86a	14.68b	344.54b
	3	30.88c	7.93b	1.09b	1.71a	47.27a	11.11a	354.11b
Overall Means		23.96	8.91	0.83	1.57	53.17	11.56	297.50

[1]Means within column groups of 3 followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of three observations.

fat. It could be assumed that companies changed dressing type, type of chicken, or added some more water. Calorie values are fairly consistent, except for Brand K which had large variations in fat content.

Without doubt, ham itself could vary in composition, leading to some variation in ham salad composition. The composition of ham salad from five different companies is shown in Table XIII. Ham salad from Company F had the highest values of fat, protein, and fiber and the lowest value of carbohydrate. Brand L had the inverse results of those of F, and also had the highest content of moisture. Brand D had the second highest contents of fat and the third highest carbohydrate, and the lowest value of fiber. Variation in calorie value was very wide. Brand D had the highest value which was about one and one-half times of that of the lowest one, Brand L.

The composition of ham salad from company - time interactions is shown in Table XIV. Variation in fat and protein values of ham salads from Company D could be assumed to be due to changing recipes to reduce fat content by adding more water. Brand F could have changed their recipe at the second pickup time, and made some errors during weighing or had poor mixing at the third pickup time. From values of Brand L, there was only a small change in the amount of protein and moisture. It could be postulated that they might just have added some more water or had errors in measuring ingredients. Brand L had small variations in fat and protein contents which could be due to the composition of ham itself. There was not much difference in Brand M's ham salad, except protein content which might come from error in weighing by plant personnel.

TABLE XIII. COMPOSITION MEANS OF COMPANIES FOR HAM SALAD

Company	Means[1,2]						
	Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
	%						Per 100 g.
D	26.74a	6.79a	0.48a	1.97ab	48.51a	15.50a	329.85a
F	26.97a	12.31b	3.38b	1.86a	50.08a	5.40b	313.52b
K	20.13b	8.78c	0.85c	2.24b	52.30b	15.70a	279.07c
L	14.36c	6.40d	0.71d	2.27b	60.44c	15.82a	218.09d
M	22.08d	7.18e	0.76d	2.01ab	52.80b	15.17a	288.15e
Overall Means	22.06	8.29	1.24	2.07	52.83	13.52	285.74

[1]Means within column groups of five followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of nine observations.

TABLE XIV. COMPOSITION MEANS OF COMPANY-TIME INTERACTIONS FOR HAM SALAD

Company	Time	Means[1,2] Fat	Protein	Fiber	Ash	Moisture	Carbohydrate	Calories
		%						Per 100 g.
D	1	34.93a	5.80a	0.51a	1.69a	40.32a	16.76a	404.58a
	2	22.17b	7.57b	0.45a	2.17a	53.29b	14.36a	287.21b
	3	23.14b	7.00c	0.49a	2.06a	51.94b	15.38a	298.76b
F	1	21.12a	13.49a	3.37a	2.31a	52.40a	7.31a	273.32a
	2	31.47b	12.70b	3.39a	1.70b	47.21b	3.53a	348.13b
	3	28.32c	10.72c	3.40a	1.57b	50.64a	5.34a	319.12c
K	1	19.74a	9.82a	1.14a	2.15a	47.89a	19.25a	293.95a
	2	21.23a	8.12b	0.70b	2.16a	54.63b	13.16a	276.21b
	3	19.41a	8.40b	0.71b	2.41a	54.38b	14.69a	267.06b
L	1	14.45ab	5.99a	0.73a	2.36a	59.85a	16.63a	220.47a
	2	15.29a	6.73b	0.77a	2.31a	59.57a	15.33a	225.84a
	3	13.33b	6.49b	0.63a	2.15a	61.90a	15.50a	207.95b
M	1	23.74a	7.50a	0.73a	2.02a	52.06a	13.95a	229.49a
	2	20.00b	6.52b	0.87a	2.15a	53.83a	16.63a	272.60b
	3	22.50a	7.53a	0.67a	1.86a	52.52a	14.92a	292.36a
Overall Means		22.06	8.29	1.24	2.07	52.83	13.52	285.74

[1]Means within column groups of 3 followed by the same letter are not significantly different at the 5% level of probability.

[2]Means of three observations.

Variations among salad companies or within salad companies among different pickup times for one salad type have been discussed. Without doubt, variation among different salad types would be expected, because meat and cheese-type salads certainly provide more protein than vegetable types. Other variations were also evident. So the reason for comparison among different salad types was to show the nutritional value among them. To compare the nutritional contribution that one type of salad would make compared to another type, one can look at overall means for the various types of salads.

The overall means and ranges of compositions among the five different salads are shown in Table XV. Pimento cheese gave the highest nutritional value among five different salad types. This type of salad had the highest calories, fat, protein, and ash content, the second highest content of carbohydrate and the lowest content of fiber and moisture. It also had the widest range in fat, moisture and calorie content, and had the narrowest range in fiber composition. Cole slaw had the highest fiber and moisture contents and the lowest contents of protein and calories. From Table XV, cole slaw gave the narrowest range in protein and ash composition. Potato salad had the lowest value of fat, the second lowest content of calories and the highest carbohydrate content. It also gave the narrowest range in fat and moisture content, and the widest range in ash content. Chicken salad had the second highest values of fat, protein, and calories, and the widest range in protein content and the narrowest range in carbohydrate content. Ham salad gave the second highest values of ash and carbohydrate and the third highest value of fat, protein and calories, and gave the widest ranges in fiber and carbohydrate compositions.

TABLE XV. OVERALL MEANS AND RANGES OF COMPOSITION AMONG SALAD TYPES

	Composition													
Salad Type	Fat		Protein		Fiber		Ash		Moisture		Carbohydrate		Calories	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
	%												Per 100 g.	
Cole slaw	11.71	3.18-28.56	1.19	0.82- 1.67	2.01	0.89-3.46	1.07	0.56-1.91	72.69	59.61-81.99	11.33	2.55-17.65	155.50	79.18-291.84
Pimento cheese	27.47	12.36-51.03	9.53	7.63-11.79	0.53	0.34-0.87	3.53	2.65-4.24	43.57	23.29-53.96	15.38	6.41-23.99	346.84	[illegible]
Potato salad	9.38	4.29-21.56	1.63	0.98- 2.44	0.85	0.41-1.52	1.29	0.53-2.21	68.50	59.98-81.93	18.35	9.68-25.44	164.36	89.96-257.56
Chicken salad	23.96	10.75-33.14	8.91	5.46-15.00	0.83	0.59-1.16	1.57	0.73-2.18	53.17	42.59-65.69	11.56	7.74-17.23	297.50	183.72-364.73
Ham salad	22.06	12.27-35.22	8.29	5.62-13.61	1.24	0.42-3.63	2.07	1.36-2.74	52.83	39.70-63.32	13.52	0.34-20.19	285.74	[illegible]

Ingredients in salads would be one of the most important reasons to cause variations in composition. Lists of ingredients for salads from three companies, F, M, and L, are included in Appendix I. Ingredients were not listed on packages of salads from K and D, the two delicatessen operations.

CHAPTER V

SUMMARY

Because nutritional labeling will become a necessity on many packages of foods, including prepared salads, and amounts of salads purchased are increasing, analytical data on commercial salads need to be accumulated. Such information can form a data base for nutrition labeling.

Five types of salads from five companies were obtained at three separate times. These were analyzed for fat, protein, fiber, ash, moisture, carbohydrate, and calories. Methods for analysis were those recommended by the FDA for compliance with nutritional labeling regulations.

The following conclusions were made from the studies:

1. Composition of each type of salad varied with company.

2. Different types of salads were different in composition.

3. For one salad type from one company, composition varied with time when it was made.

4. Analytical errors, as expressed by coefficients of variation, should reflect what would be expected in a typical food analysis laboratory.

Possible reasons for the significant variations among the samples were discussed. These included such things as recipe changes, operator errors, and poor operational control.

Comparisons of calorie values among the data indicated wide variation of this factor, both within and among companies, and among salad types.

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APPENDIX

Cole slaw

Company F: Cabbage, mayonnaise, carrots, peppers, vinegar, oil, sugar, salt.

Company L: Cabbage, mayonnaise, carrots, vinegar, and spices.

Company M: Cabbage, salad dressing, pickles, carrots, cooked celery, green peppers, lemon juice, spices.

Pimento cheese

Company F: Cheddar cheese, American cheese, mayonnaise, pimentoes.

Company L: Cheese, mayonnaise, pimento and spice.

Company M: Pasteurized process cheese food, salad dressing, red peppers, pimentoes, salt, less than 1/10 of 1% Sodium Benzoate.

Potato salad

Company F: Potatoes, mayonnaise, pickles, pimentoes, eggs, celery, mustard, vinegar, oil, salt.

Company L: Potatoes, mayonnaise, celery, pickles, red and green peppers, eggs and spices.

Company M: Potatoes, mayonnaisse, celery, pickles, green peppers, onions, pimentoes, salt, spice.

Chicken salad

Company F: Chicken, mayonnaise, pimentoes, pickles, celery, salt.

Company L: Chicken (natural juices and salt), mayonnaise, celery, sweet pickles, green peppers and cracker meal.

Company M: Mayonnaise, chicken, cooked celery, pickles (cucumber, vinegar, salt, alum, sugar, turmeric, spice flavors and polysorbate 80), cracker meal (flour, water).

Ham salad

Company F: Ham, mayonnaise, pimentoes, pickles, celery, salt.

Company L: Chopped ham (ham, ham shank meat, dextrose, salt, water, corn syrup, Sodium Tripolyphosphate, Sodium Nitrite), mayonnaise, celery, pickles, green pepper.

Company M: Chopped ham (ham, water, salt, Sodium Nitrite, sugar), salad dressing, red peppers, pimentoes, pickles (cucumber, vinegar, sugar, tumeric, alum, spice flavors and Polysorbate 80).

VITA

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