CONSUMER TESTING OF SCRAMBLED EGG-SOLIDS

By

John William Tuttle

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ABSTRACT

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There is a dearth of information on the use of egg solids at the individual consumer level. Egg solids are not being marketed in consumer packs. A quality egg solid, packed for consumer use, objectively advertised, and preceded by consumer education programs might be the way to raise per capita egg consumption by putting a useful product into the hands of consumers. This research was designed to determine whether consumers could identify the difference between scrambled fresh eggs and scrambled egg solids, and then if differences were detectable, which was preferred.

Commercially available egg solids were tested. Commercially available products were used rather than a test tube or laboratory product that might be months or years away from commercial production. A fortified whole egg solid was the first product tested. This product contained approximately 8 per cent corn syrup on a liquid basis before it was spray dried. A nonfortified whole egg solid of the highest quality obtainable from commercial sources was specified for the second product tested. A patented egg product was the third product tested. This product was being recommended primarily for scrambling.

Four different groups were used for the taste panels. Panel A was composed of wives of Michigan State University campus based extension specialists. These women met for an educational program on consumer preference testing and were used for trial 1. The Michigan State University - Wayne State University Consumer Panel, Panel B, was used for trials 2 and 10. This panel was designed to determine preferences of consumers with annual incomes ranging from under $2,000 to over $10,000, of ages 31 to over 54, and educational range from under 8 to over 14 years. The third group of panelists, Panel C, were members of a Michigan State University Food Science Class. This group was being trained in organoleptic food testing techniques. The fourth group of panel members, Panel D, were chosen from the Food Science, Dairy Science, Animal Husbandry, and Poultry Science Departments of Michigan State University. The fourth group of panel members were grouped as secretaries (homemakers), students, and professional staff.

A method of scrambling eggs, both from fresh eggs and from egg solids, that gave a true picture of their consistency, color, flavor, and palatability was developed. This method lent itself to the preparation of scrambled eggs for large numbers of panel participants and was repeatable.

The results from the 10 trials of this study indicate that:

A. The fortified whole egg solids (containing 8 per cent corn syrup before drying) were too sweet to be readily acceptable by consumers for scrambling purposes when fresh eggs were available.

B. Whole egg solids were preferred to fortified whole egg solids for scrambling purposes.

C. Scrambled fresh eggs were definitely preferred to scrambled whole egg solids.

D. The patented egg product was preferred to fresh eggs.

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INTRODUCTION

Through the years improvements in quality have been made on egg solids. This has been possible through the use of well researched techniques and/or procedures using spray dryers, controlled bacterial fermentation, pasteurization, automatic machine breaking, acidifying, multi-stage dryers, desugaring, cooling, gas packing, fortifying, and quality breaking stock.

Commercial bakeries, candy makers, and other food manufacturing companies are using more and more egg solids. They are doing so because of the ingredients, economy of the dried products, standardization of the product, lower labor and storage costs, and because of satisfactory action of this form of the egg in the final product.

There is a dearth of information on the use of egg solids at the individual consumer level. Apparently egg solids are available that could be used for home baking, home candy making, and other home cooking uses because of the acceptance of products that have been made using egg solids. Egg solids are not being marketed in consumer packs. A quality egg solid product, packed for consumer use, objectively advertised, and preceded by consumer education programs might be one way to increase per capita egg consumption in the United States by putting a useful product into the hands of consumers.

Peak egg consumption in the United States occurred in 1945 when 403 eggs per capita were consumed. Egg consumption has declined since

that time and was estimated at 307 eggs per capita in 1965. This decline of 23 percent in 20 years resulted despite an expanding egg industry. However, consumption in pounds of eggs (1947 - 42 pounds 12 ounces vs 1965 - 38 pounds and 6 ounces) has declined only 11 percent, 4 pounds, 6 ounces.

Wilhelm (1966) stated "Egg consumption has declined since 1945 even though price per dozen has also declined, 37.7¢ per dozen in 1945 to 32.4¢ per dozen in 1964. But production has not declined! Production was 56.2 billion eggs in 1945 and 64.5 billion in 1964."

The decline in per capita consumption since the high of 1945 has been due to (1) a change to a more normal pre-war situation as other protein foods became readily and economically available; (2) a change in American dietary habits with less emphasis on breakfast; and (3) fewer eggs consumed on farms since fewer farmers are keeping layers and since the total farm population is decreasing.

The apparent per capita consumption of eggs in the United States represents estimates of the commercial and hatching eggs used, plus eggs used by military, plus imports, minus exports, divided by the estimate of population. Wilhelm (1966) estimated the 1965 domestic disappearance of United States eggs as follows:

Used for egg products	307 shell eggs available
	34 (11%) dried, frozen, etc.
	273
Used by restaurants	37 (12%)
Available as shell eggs	236 average of 4.5 eggs per week
Used at breakfast	177 (75%)
Used in cooking	52 baking, dressings, etc.
Used at other meals	7

In this paper, it is the 11 percent of available eggs that go into egg products that is of interest. This 11 percent, or 1 out of every 9 eggs laid and marketed in the U.S., is a significant segment of the egg business. As integrated production has increased, interest has been shown in the possibility of adding egg-breaking and/or egg-drying facilities to the business. Production from such facilities must be marketed. This research was designed to determine whether consumers could tell the difference between scrambled fresh eggs and scrambled egg solids and then if differences were detectable, which they preferred. If egg solids are comparable to fresh eggs for scrambling purposes, marketing programs aimed at the consumer could be implemented.

REVIEW OF LITERATURE

History of the Egg Drying Industry

Records of Koudele and Heinsohn (1960) indicate that in 1878, a St. Louis, Missouri firm was transferring egg yolks and albumen, by a drying process, into a light brown, meal-like substance. From 1895 to 1905 a number of plants began operation and dried eggs were shipped to Alaska and even China to be used by the United States Army stationed there.

Down through the years several types of dryers have been used. The earliest dryers were the rotary-drum type. In 1907, the belt-type dryer was invented and with this invention, flake-dried whole eggs and yolk were produced. Belt drying methods were employed in China for this kind of production. The liquid was spread in thin films on continuous aluminum belts moving through a hot air stream (Miller, 1945). Attempts to dry egg white by this system were apparently unsuccessful due to the difficulty of spreading the liquid and removing the dried products. The first spray dryer was invented in 1901. During the mid-1930's the spray dryer, which had been used for drying milk, was adapted to dry whole eggs and yolks (Koudele and Heinsohn, 1960). In this dryer, liquid egg was forced under pressure of approximately 3,500 pounds per square inch through fine nozzles into the drying chamber. Heated filtered air forced through the chamber by a powerful blower, came in contact with the fine spray of liquid egg causing it to dry instantly

and fall as a fine golden powder. Around 1939, it was adapted to dry whites as well as whole eggs and yolks. Widespread use of this relatively efficient dryer was a significant technological factor in the rapid expansion of dried egg production during World War II. Spray drying was the most common method for the production of egg solids in 1964 (Bergquist, 1964).

In drying by the tray method, liquid egg was run onto metal trays, usually aluminum, of any convenient size or shape. The liquid egg, usually the liquified white, was poured directly onto the trays or pumped to them through flexible tubing fitted with hand-controlled nozzles which run from the tanks of liquid egg to the drying room. The trays were placed on shelves in specially constructed cabinets. Hot air was forced through the cabinet, entering on one side and escaping through appropriate ducts on the other side. From 6 to 12 hours was required to dry one batch at a temperature of 110° to 120° F. The dry material was removed from the pans, collected in convenient bins, and graded for market. Egg white was the principal product dried by this method, although egg yolk was sometimes dried in the same way (U.S.D.A., 1941).

The Food Research Laboratory, Bureau of Chemistry was created in 1907 by the Department of Agriculture to conduct technological studies primarily in egg and poultry processing (Koudele and Heinsohn, 1960). Initially most of the activities centered on poultry meat and shell eggs. But a legal case (Keith, 1914) over frozen eggs clearly indicated how little was known about the sanitary and refrigeration requirements for egg products. A group of scientists under the direction of

Dr. Mary E. Pennington began conducting basic research regarding the preservation of egg products. As information became available, Dr. Pennington, in line with her laboratory's motto of "Clean, Cool, Cooperate," helped the industry improve its physical facilities and technology. Sparkling-white egg breaking rooms, models of sanitation, began to appear. Improved techniques in breaking eggs and handling liquid eggs were adopted to minimize bacterial counts. According to Dr. Pennington (1916):

> The laboratory findings practically revolutionized the apparatus used and the routine followed in the breaking room. Instead of the haphazard collection of odd pieces of china, glass and tin, there were evolved machines accurately adapted to the work to be done; and the careless, inconsequent methods of cracking and emptying the shells were replaced by a standardized, definite routine, making for both quality and efficiency.

Separating the white from the yolks was a very time consuming process when girls flipped the yolk back and forth from first one half of the shell to the other. In 1912, the hand separator was invented by Harry A. Perry. Its use greatly improved the efficiency and speed of breaking and contributed to the development of large-scale operations (Koudele and Heinsohn, 1960).

Scrambled eggs made from flake-dried eggs were served at a White House breakfast during World War I (Koudele and Heinsohn, 1960). This event paved the way for limited use of sample packages of dried eggs in a few army camps. While the U. S. Army was not prepared to use dried eggs during World War I, the soundness of the idea was later confirmed by developments during World War II, 1941-45, when military purchases

were equivalent to about 57 million cases, or 8 percent of total farm egg output (U.S.D.A., 1946).

The opening of the Panama Canal in 1914 made possible direct shipments of egg solids from China to New York City at relatively low rates. Imports were heavy from firms in China owned or supervised by British or American businessmen (Koudele and Heinsohn, 1960).

Actually, the Chinese dried albumen was superior to the American product in shelf-life and whipping qualities because of one important step in processing (Brooks and Taylor, 1955). Liquid white was allowed to ferment spontaneously before drying with the effective agents being primarily bacteria, derived fortuitously from shells during egg breaking.

At the time it was unknown why the Chinese were able to produce a better product than the Americans could. But years later, American scientists discovered the important role played by bacterial fermentation (Koudele and Heinsohn, 1960). The process improved shelf-life by removing the glucose naturally present in egg whites and, in addition, improved the product's whipping qualities by removing yolk contamination and the protein mucin. The Chinese were aware of the superior performance of their albumen product and tried to keep the methods secret.

The Revival of Egg Drying in the United States

Several factors were responsible for stimulating the resumption of egg drying on a commercial scale in the United States. The Chinese Civil War outbreak in 1927 tended to curtail Chinese dried egg exports while low egg prices in the United States during the early 1930's

resulted in a more favorable competitive relationship. Higher import duties were also established in 1930 on dried eggs.

The spray dryer, which had been used for drying milk, was adapted to dry whole eggs and yolks. Product quality was enhanced during the late 1930's by the development of equipment that would remove all pieces of egg shell and chalazae from liquid egg. Quality control laboratories also came into use (Koudele and Heinsohn, 1960).

By 1938, pasteurization of liquid whole egg was practiced on a commercial basis for the purpose of improving the keeping quality of egg products (Goresline, 1954). Another major contribution was the discovery in 1941 that removal, by the bacterial fermentation technique, of glucose from liquid albumen before drying resulted in albumen solids with remarkable stability (Brooks and Taylor, 1955).

Expansion During World War II

In early 1941, there were 15 drying plants producing dried eggs in the United States. On the basis of a 20-22 hour day and 300 days of operation, these plants could have possibly produced 50 million pounds of dried whole egg product (U.S.D.A., 1941). In September, 1943, domestic egg-drying capacity was estimated at 420 million pounds annually (U.S.D.A., 1943). Production of whole egg solids expanded almost a thousand-fold from 1940 to 1944 (Table 1; U.S.D.A., 1953). This expansion, according to Koudele and Heinsohn (1960), occurred despite a wartime shortage of strategic metals to manufacture new drying equipment and the lack of trained personnel for industry and the government for its inspection program.

Table 1--Whole egg solids: annual production United States, 1940-44 (U.S.D.A., 1953)

Year	Production (1,000 pounds)
1940	392
1941	31,241
1942	226,127
1943	252,903
1944	311,369

Product Acceptance During World War II

Before the government would accept dried eggs for shipment, the powder had to pass rigid inspection tests for palatability and other quality criteria. The Federal Food and Drug Administration had established standards of identity for egg products in 1939. The U. S. Department of Agriculture purchased considerable quantities of dried eggs on the basis of percent solids, percent fat, solubility and palatability (U.S.D.A., 1964).

It was impossible to store the product under continuous refrigeration until it was consumed and objectional off-flavors developed which seriously affected its usefulness. An objective appraisal of the quality and shelf-life of most of the dried whole eggs produced during World War II follows:

(1) The initial quality .....was good (Lineweaver and Feeney, 1950). The bad reputation given to dried eggs during the war was justified because the product deteriorated seriously between the time it was prepared and the time it was offered for consumption.

(2) During World War II, a good quality dehydrated egg with a high palatability score was prepared, but it became unstable during storage and under the transportation conditions which were necessary

during war times, so that a certain stigma became attached to the term "dried eggs". In the Armed Forces some of this stigma was attributable to the poor methods of preparation in the Army mess (Kahlenberg, 1963).

(3) According to Brooks and Taylor (1955), the dried whole egg manufactured before 1939 was not intended to be eaten as a scrambled egg or omelette, and for such a purpose it was often an article of indifferent quality. The dried egg manufactured during the war was not entirely successful, although the quality was greatly improved. When freshly prepared under proper conditions, the product was largely deficient only in aerating power, but transport delays often prolonged the interval between manufacture and consumption to such an extent that the flavor was impaired and the aerating power was diminished still further.

(4) During World War II, tremendous quantities of dried eggs, primarily dried whole eggs, were produced for the Armed Forces and the lend-lease program. The impetus of this large scale production brought on extensive research efforts, the results of which, unfortunately, were not generally available and put into practice until late in the war. As a result some quantities of poor quality dried eggs reached servicemen and a certain stigma became attached to their use (Forsythe and Miyahara, 1959).

(5) The Author of this thesis spent four years in uniform during World War II, two of them in the South Pacific Theater, and can say from personal experience that deteriorated whole-egg powder was the source of many complaints.

(6) Bigelow (1959) tells of an incident related by an Army officer indicating the ingenuity of one mess sergeant:

"One of my duties as battalion mess officer in Germany was to check the daily menu against the cook's work sheet.

One day when scrambled eggs were on the breakfast menu, the cook's work sheet listed powdered eggs, followed by the note, 'Add one broken egg shell'. Perplexed, I asked the mess sergeant why he was feeding the troops egg shells with their scrambled eggs.

'Just using a little psychology, Sir,' he replied. 'The boys don't go for these powdered eggs at all, and when they bite into a piece of egg shell they think ther're eating the real 'McCoy'. There's hardly any waste nowadays.'"

This quality deterioration did not go unnoticed; federal, state and industry scientists started a program that became known as the Co-ordinated Dried Egg Research Program. Some of the recommendations included: more sanitary handling of liquid melange; preheating or pasteurization before drying; rapid cooling of the product after drying; production of low moisture (2%) powders; and packaging the powder under inert gasses in hermetically-sealed containers (U.S.D.A., 1950).

After the use of recommended procedures had begun, the improvement in initial quality and in the shelf-life of commercially dried whole egg was very marked. Stewart (1944), the coordinator of the Coordinated Dried Egg Research Program, stated:

"Whereas the product of a year ago was, in numerous cases, poor in sanitary quality and initial palatability, with a shelf-life of only a very few weeks at 100° F., and a few months at 70° F., it can now be prepared with low bacteria count, excellent flavor, and with a shelf-life of several months at 100° F. and about a year at 70° F."

In spite of all the difficulties with deterioration of dried eggs during World War II, their use in a special diet resulted in almost miraculous speedups in recovery of many war-wounded and starving victims of concentration camps. The diet consisted of water, plus a mixture of powdered egg and powdered milk which tasted like egg nog or ice cream. Pollock (1946) reported that of 92,000 soldiers liberated from German prison camps and treated with this bland diet, only eight died, although 40 percent of them suffered from severe malnutrition and at least 80 percent were undernourished.

At Recovered Allied Military Prisoners' Camps, daily sick call rate averaged more than 20 percent when the men were fed an ordinary army ration. About four-fifths of the complaints were due to stomach and intestinal disturbances. One week after the bland diet, consisting of a mixture of powdered eggs and powdered milk in water, was introduced, the sick call rate dropped to 4 percent. There were no cases of nausea and vomiting, and only 15 percent of the complaints were due to intestinal disturbance (Pollock, 1946).

The egg and milk mixture sped Army wounded and post-operative patients in Europe back to duty in about one-third the average time. The high protein content of the mixture, together with its high caloric value from the fat and carbohydrate, and its lack of irritation to the stomach and intestines constitute its advantages. Prolonged convalescence could be a rarity if this war lesson were applied.

Dried Eggs Officially Renamed Egg Solids

Unfortunately, reasons for the off-flavors of dried whole eggs were not discovered until near the end of World War II. During the war

a certain stigma became attached to the term "dried eggs" by the nation's Armed Forces. This was a challenging problem that the industry knew must be overcome if dried eggs were to be acceptable to the general public.

In 1952, domestic dryers organized the Egg Solids Council to improve and promote the use of egg solids. In recognition of technical achievements resulting in control of off-flavors and greatly improved product stability, it was decided to drop the term "dried eggs" and to adopt the term "egg solids" (Koudele and Heinsohn, 1960).

Production Problems

Procurement.--According to Forsythe and Miyahara (1959), one of the more important changes that had taken place to improve the quality of egg solids was the change in the production and procurement of the eggs for breaking. No longer were the breaking-stock eggs looked down on by the rest of the egg industry as the surplus--the eggs no one else would buy. Egg breakers had imposed such rigid standards on shell eggs that in some areas it had been necessary to start large egg production units where thousands of cases of eggs could be produced under the most carefully controlled conditions at costs low enough to warrant substantial savings to the consumer. The improvements in quality of such eggs, over those previously produced on random farms scattered all over the Middle West, with little or no quality control, had resulted in raw materials for the egg solids manufacturer with more desirable color, greater solids and fat content in the yolk, and with whites that had superior functional and foaming properties. It was now possible to buy current production fresh dried egg solids every month in the year. This

procurement method avoided the storing of eggs and tying up large quantities of capital in inventories.

Producing shell eggs for breaking has not been generally practical as the cost of these eggs has been too high. However, production cost on commercially-produced eggs has been going down, and it will probably continue to decline. This, together with the disappearance of the farm flock and stricter quality requirements for breaking stock, is expected to eventually make the costs of commercially produced shell eggs competitive for breaking (Newell, 1966).

The necessity for locating more adequate sources was heightened by the growing emphasis on processed egg products by institutional users and intensified competition among breakers for available supplies (Anonymous, 1966). As farm flocks and layer population in the midwest shrank in the last decade, all midwestern breakers' procurement problems intensified.

In recent years, procurement has involved more than just a matter of obtaining "eggs." For example, there is the matter of liquid yield. Some strains of hens lay eggs with a higher liquid yield than other strains (Voss, 1961). Also, yolk color, now that few chickens are permitted to roam outdoors, calls attention to layer diet (Koudele and Heinsohn, 1964). Price per dozen may not be the only consideration, as a consequence.

Where once breakers could acquire a year's supply in the flush egg production months of February through June--sometimes at distress market prices--a leveling out in egg production month to month has presented new problems both with respect to price and supply.

Salmonella.--The salmonella contamination threat is well documented. Tugwell and Mundt (1957) inoculated S. C. White Leghorn females with salmonella previously isolated from egg products. Egg meats from intravenously inoculated hens yielded negative results when cultured. Egg meats from orally inoculated hens also gave negative results. A similar cultural examination was made of the egg shells. Nine percent of the shells examined were found to be contaminated. These data support the probability that improper handling of eggs, either by the producer or later by the processor, provides the necessary environment for the organisms to gain entrance to the egg contents.

Mundt and Tugwell (1958) infected Single Comb White Leghorns with 6 species of salmonella in 4 trials, 2 by oral introduction and 2 by intravenous injection. No organisms were recovered from the egg meats cultured. Organisms were recovered from the shells 24 days after infection and from fecal material 35 days after infection. They concluded that infection of egg meats with the organisms used in their work by the infected hen was improbable; and that egg shells were contaminated with Salmonella spp. in the cloaca only after they had been produced and released from the uterus or immediately thereafter when eggs came in contact with contaminated surface.

Faddoul (1963) reported an alarming increase in the number of salmonella isolations from human sources being recorded in several states. It was evident that adequate prevention methods for human salmonella infections had not been affected. The presence of these pathogens in avian food products was a matter of great concern to all segments of the poultry industry.

Turnbull (1964) reported on the National Conference on Salmonellosis, Atlanta, Georgia, March 11-13, 1964. Those in attendance at this conference recognized the fact that the poultry industry does have a genuine problem with respect to salmonella infections. Further processing of foods greatly increased the incidence of infection. Salmonella organisms had been found in far too high incidence in cake mixes. The baking of the cake destroyed the organism but children picked up the infection prior to the baking process when they "licked the spoon" from the mixing bowl. Many problems such as this will have been eliminated when all egg processors resort to pasteurization.

Galton (1964) reported that raw or inadequately cooked eggs were used in many types of foods such as custards, cream pies, eclairs, eggnog and milk shakes. These foods often represented a major part of the diet of young, aged, or debilitated individuals who were susceptible to salmonella infection. The salmonella organisms may have entered the egg by ovarian infection, or the shell may have become contaminated from fecal material. Up to 100 percent of some lots of frozen and dried eggs were found to contain salmonella. As a result, reports implicating processed egg products as the source of salmonellosis in man have appeared frequently. The urgency for production of liquid, frozen, or dried-egg products free from contamination with salmonellae was obvious.

Because it was economically impractical to produce products from only naturally clean eggs and because of the inherent difficulties in producing all eggs free of salmonella contamination, a method to eliminate salmonella during processing was necessary. Pasteurization of liquid whole egg and egg yolk had been available for more than a decade

although it had been adopted by only a few processors and was usually used at the request of the buyer. Until recently adequate pasteurization of liquid egg white had not been possible because of serious damage to the egg white proteins. The Western Regional Research Laboratory, U. S. Department of Agriculture, recently developed a method to stabilize the egg white so that it is heat stable (U.S.D.A., 1965). This stabilized egg white can be effectively pasteurized without damage by the procedure now used in the United States for whole eggs, i.e., heating to 140-143° F. for 3-1/2 to 4 minutes. Many countries (Canada, United Kingdom, Denmark, Germany, Italy) and at least one state have passed regulations requiring that only salmonella-free products as determined by bacteriological examination be sold.

As the industry became aware of its salmonella contamination threat, and in particular when the Poultry Division, Consumer and Marketing Service, U.S.D.A., put into effect its requirement that all egg products emanating from a U.S. inspected plant had to be pasteurized, egg breakers have been doing a great amount of soul-searching regarding egg sources (Anonymous, 1966).

This regulation (U.S.D.A., 1967) states that all egg products prior to being released into consumptive channels shall be pasteurized at not less than 140° F. and held at this temperature for not less than 3-1/2 minutes except that where heat treating of dried whites is required, products shall be heated throughout for such times and at such temperatures as will result in a salmonella negative product. Egg products, liquid or dried, shall be sampled and tested for the presence

of salmonellae. Any product found to be salmonella positive shall be reprocessed.

Kraft et al. (1967) reported on a study that was conducted during 2 consecutive years to determine sources and levels of bacterial contamination in commercial liquid egg from 2 federally inspected plants, and to relate sanitation practices to bacterial counts and salmonella in the liquid product. This study revealed that the bacterial contamination depended on differences in plant sanitation and bacteriological condition of the shell eggs used for breaking. In one plant where sanitation practices were exacting, no salmonella were isolated.

Ingredient handling.--As the trend toward automation progressed, ingredient handling costs became very important (Kahlenberg, 1963). The lack of flowability of whole egg and yolk solids slowed their adoption on commercial continuous operations. Due to the high fat content of whole egg and yolk solids, flowing properties were very poor and the product could not be conveyed and measured automatically. This problem was especially accentuated when whole egg or yolk solids were packed into drums at temperatures above the melting points of the egg fats (85-90° F.) and when later refrigeration allows the fat to solidify. As a result the product had to be literally dug out of the package and manually or mechanically forced through the handling equipment. It was found that an anti-caking agent, sodium-silico-aluminate, added at levels of 1.5 to 2.0% would make whole egg and yolk solids free flowing without affecting performance (Kahlenberg, 1963).

Consumer Usage

According to Ballas (1965), the infinite variety of ways in which table eggs are served fails to cover the full scope of ways that eggs fit into the diet of the world's best-fed nation. By no means is our egg consumption limited to the eggs we eat as just eggs. Over 701,320,000 pounds (roughly 584,433,333 dozen) of eggs are broken out in the United States annually and are a major factor in the quality production of noodles, macaroni, cakes and bakery goods, candies, and mayonnaise.

An egg contains approximately 74 percent water. During the drying process almost 99 percent of the water is removed, and the egg is reduced to about one-fourth of its original weight. Use of egg solids therefore greatly reduces the need for storage space and saves transportation costs. Other reasons for the ready acceptance and increasing usage of egg products by food industries and institutions according to Koudele and Heinsohn (1964) are: (1) convenience and ease of handling, (2) economy of purchasing separated products--yolks and egg whites which have specific functional properties, (3) availability of various types and forms of egg products in quantity for large-scale utilization by food manufacturers (4) improvement in shelf-life, (5) freedom from microorganisms, (6) standardized egg solids in terms of quality and performance, and (7) the development of egg solids with flavor and performance comparable to those of fresh shell eggs.

According to recognized baking technologists there are at least six functions performed by eggs in cakes and similar products. Cicciu, (1965), lists the following functions:

(1) Binding Action
(2) Leavening Action
(3) Emulsifying Action
(4) Flavor
(5) Color
(6) Nutritive Value

While the basic functions of egg solids are identical to those of frozen eggs, in many cases egg solids have special "built-in" properties and the maximum value of these products cannot be obtained without minor changes in formulation and mixing techniques. Most egg solid manufacturers can supply technical service personnel to assist in formula readjustments (Forsythe and Miyahara, 1959).

A wide variety of egg solid products have been developed and are commercially available for specialized application in the baking field. In the development of these products, primary attention has been to the functional and organoleptic roles demanded in the different products. Some of the products are standard whole egg solids, stabilized whole egg solids, whole egg solids-special blends, standard egg yolk solids, stabilized egg yolk solids, and egg white solids.

According to Cicciu (1965) the product analyses are:

(1) Standard whole egg solids

Moisture	4.0 + or - 0.5%
Fat	40.0 + or - 2.5%
Protein	46.0% Minimum
Glucose	1.5% Maximum
Other	4.8%

This type product is used in items where the primary functional property is not foaming, such as in cookies and fat-bearing cakes.

(2) Standard yolk solids

Moisture	4.0 + or - 0.5%
Fat	57.0% Minimum
Protein	32.0 + or - 1.0%
Glucose	0.4% Maximum
Other	2.5%

This type product is used in various prepared mixes and fat-bearing cake, but not where the primary functional property is foaming.

(3) Standard egg white solids

Moisture	7.5 + or - 0.5%
Fat	0.25%
Protein	80.0% Minimum
Glucose	0.1% Maximum
Other	5.0% + or - 0.5%

This type product is used most generally in Angel Food cakes and meringues.

Cicciu (1965) also states that stabilized eggs are available. This type product has been stabilized through the removal of glucose by the enzyme or controlled fermentation process. The stabilization results in additional shelf-life for the egg product as well as for mixes prepared from the egg product. Because of greater aerating properties and improved solubility and dispersement properties many companies now use corn syrup solids in the production of dried egg products.

Ballas Fortex #500 Egg Solids is a mixture of egg yolks, special syrup and salt blended in liquid eggs before being spray dried. The analysis is:

Moisture	3% Maximum
Fat	47.0% Minimum
Protein	26.0% Minimum
Granulation	100% through USBS # 16 screen

This product was specially prepared to replace liquid whole egg, sugared

yolks, or blends in sweet doughs and doughnuts. It is recommended for replacing sugared yolks in sweet dough and ice cream (Ballas, 1966).

The United States Department of Agriculture has completed a study on the "Present and Potential Use of Egg Products in the Food Manufacturing Industry" (Enochian and Saunders, 1963). Firms selected for study included bakeries, confectioners, premix manufacturers, and other miscellaneous food manufacturers. Of 333 completed interviews, 210 were with bakeries, 34 with confectioners, 28 with premix manufacturers, and 61 with other food manufacturers. This study indicated that food manufacturers were generally satisfied with the services being offered to them by their egg suppliers. Most firms were of the opinion that suppliers were doing a good job in furnishing them with commodity and price information and price-supply protection. They also rated egg suppliers favorably on delivery performance and on handling complaints. Food manufacturers were of the opinion that, in general, egg suppliers were not performing as well as other ingredient suppliers in the areas of special product service, research and development activities, and institutional advertising. It was frequently pointed out, however, that some large egg suppliers provided excellent services along these lines.

Based on the findings of Enochian and Saunders (1963), the use of dried egg products and premixes containing eggs can be expected to increase substantially in the future. Increases in the use of dried eggs will be largely at the expense of liquid and frozen eggs because the convenience aspect of dried eggs and premixes appeal strongly to food manufacturers.

Feeney (1965) reported there was extensive interest and development in the use of egg solids by the pre-mix or ready-mix industry. Magazines published for the American housewife feature advertising spreads for such mixes. This advertising provoked a response that was both of a positive and negative nature. However, high-quality egg solids were being produced and the trend was for their inclusion by most pre-mix manufacturers.

Drews (1966) reported that most of the major egg solids processors have had a long background of 25 to 40 years in technical egg processing. The leaders have not wasted their time, and much progress has been made in special techniques, in special mixes, in effective service to the commercial users, and in operational efficiencies. Egg nutrients are not low in cost compared with other nutrient sources available. In the face of the trends toward convenience foods, expanding manufacturing of pre-mix and pre-cooked baked goods is in the hands of people competent to develop and utilize extenders to replace forms of egg products.

It is apparent that egg solids have established themselves in the food manufacturing industry, Tables 2, 3, 4, and 5 (Enochian and Saunders, 1965). As labor becomes more of a problem in the food manufacturing industry, greater usage will be made of egg solids as a means of lowering costs.

Cicciu (1965) made comparisons between dried egg solids and frozen eggs in April 1965, from an economic viewpoint, Table 6. Obviously, from the data presented in this table dried egg solids have an economic advantage over frozen eggs except in the case of sugared

Table 2--Percentage of manufacturers of miscellaneous food products that used egg products or egg substitutes in various forms, 1960 (Enochian and Saunders, 1965)

End product	Shell eggs	Liquid eggs	Frozen eggs	Dried eggs	Egg substitutes	Total
	Percent					
Baby foods	0	0	80	20	0	100
Soups	10	0	30	0	60	100
Noodles	12	9	63	16	0	100
Macaroni	13	0	74	13	0	100
Salad dressing, mayonnaise	4	0	42	4	50[a]	100
Processed meat and poultry	45	11	22	0	22	100
Processed fish and sea foods	50	0	0	0	50	100
Desserts	0	0	38	24	38	100
Pet food	0	0	0	100	0	100
Stuffings and breadings	0	0	50	50	0	100
Binders	0	0	0	0	100	100
Seasonings	0	0	0	0	100	100
Miscellaneous specialties	14	0	45	32	9	100
Other	60	0	40	0	0	100

[a]Mostly starch used for thickening in salad dressing.

Table 3--Number of bakeries by type using eggs or egg substitutes in various forms, 1960 (Enochian and Saunders, 1965)

Type of bakery	Number of firms	Percentage of firms using various egg forms				
		Shell	Liquid	Frozen	Dried	Substitutes[a]
		Percent				
Wholesale	90	13	9	83	50	13
Grocery chain	15	13	13	100	60	7
Home service	8	0	0	75	25	12
Retail	86	45	16	91	43	15
Biscuit, cracker, cookie . .	11	9	0	55	91	64
All bakeries	210	26	11	86	49	16

[a]Substitutes used and frequency mentioned include yellow and orange coloring (18), monoglycerides (7), emulsifiers (5), lecithin (5), vegetable gums (4), soy flour (3), soy protein (3), agar-agar (3), cornstarch (3) glutin (2), Irish moss (1), pectin (1), and gelatin (1).

Table 4--Percentage of confectioners using egg albumen in various forms, or egg substitutes, 1960 (Enochian and Saunders, 1965)

Egg form	Percentage of firms using[a]
	Percent
Liquid egg albumen	3
Frozen egg albumen	15
Dried egg albumen	91
Substitutes[b]	47

[a]Based on interviews with 34 firms.

[b]Substitutes used and frequency mentioned include soy albumen (8), gelatin (7), soybean lecithin (6), yellow and orange coloring (6), pectin (5), soy protein (3), agar-agar (2), vegetable gums (1).

Table 5--Use of eggs and egg substitutes in various forms by food industries surveyed, United States, 1960 (Enochian and Saunders, 1965)

Industry	Number of firms	Average quantity used per firm	Percentage of eggs used in various forms[a]					
			Shell	Liquid	Frozen	Dried	Substitute	All form
		1,000 lbs.	Percent					
Baking	210	521.3	2	5	79	13	1	100
Confectionery[b] . . .	34	176.4	0	63	26	4	7	100
Premix	28	282.4	0	0	[c]	99	1	100
Other[d]	61	443.8	34	3	60	3	[c]	100

[a]Based on actual weights, not liquid equivalents.

[b]Mostly albumen.

[c]Less than 0.5 percent.

[d]Includes firms making baby foods, meat and fish products, noodles, macaroni, ravioli, mayonnaise, salad dressing, and a variety of specialty foods.

Table 6--Price comparison of frozen eggs and dried egg solids for the same product (Cicciu, 1965)

Frozen egg types	Frozen prices	Dried egg type	Dried price	Conversion price
Egg white	14¢ lb.	Albumen solids	$1.10 lb.	.1375
Whole egg	26¢ lb.	Standard whole egg solids	.99 lb.	.2475
Plain egg yolk	49¢ lb.	Standard egg yolk	1.00 lb.	.4375
Sugared yolk	42¢ lb.	Yolk (syrup added)	.86 lb.	.4300
Fortified whole egg	31¢ lb.	Fortified whole egg	.82 lb.	.26906
Whole egg stabilized	26¢ lb.	Stabilized whole egg	.76 lb.	.2265

yolk. For comparative purposes, New York wholesale shell egg prices, Extra - 70 percent A - White - Large, for April, 1965 averaged 37 to 38-1/2 cents per dozen (U.S.D.A., 1967).

OBJECTIVES

Even though many advances have been made in the egg solids industry, little attention has been paid to the individual consumer as a possible customer for egg solids. This experiment was designed to answer the question, "Is there a commercially-available egg solid that compares favorably with fresh eggs for scrambling purposes, possibly the most simple home use?"

The objectives were:

1. To select and test commercially-available egg solids for consumer preference.
2. To determine a method of scrambling eggs, both from fresh eggs and from egg solids, that would give a true picture of their consistency, color, flavor, and texture to the consumer panelists.
3. To determine a method of presentation of scrambled eggs to a large number of panel participants.
4. To determine preference for samples presented to the consumer panels.

PROCEDURE

Products to be Tested

Three commercially available egg solids products were evaluated in this study. Commercial products were used rather than test tube or laboratory products that might be months or even years away from commercial production.

The three products evaluated were:

Product A - This product was a spray-dried fortified whole egg solid material. It was pasteurized before spray drying and was produced under continuous USDA inspection. This product contained approximately 8% corn syrup and one-half of 1% salt on the liquid basis before it was spray-dried (Pilley, 1966). The product was shipped 25 pounds net weight in a sealed plastic bag enclosed in a fiber-board drum, and required refrigeration. The recommended usage was for scrambled eggs, French toast, and other cooked or baked products. Product A was used in trials 1, 2, 3, and 4.

Product B - This product was a spray-dried whole egg solid material. It was pasteurized before spray drying and was produced under continuous USDA inspection. The specifications for this product called for it to be of the highest quality obtainable from commercial sources. Product B was shipped in a fiber carton in 3 pound net weight packages in polyethylene and required refrigeration. The recommended usage was for cookies, layer cakes, pound cakes and other products calling for

liquid whole eggs except where leavening or foam formation was required (Ballas, 1966). Product B was used in trials 4, 5, and 6.

Product C - This product was a patented egg material. The liquid egg mixture was pasteurized and then spray dried under continuous USDA inspection. Fisher (1966) reported that only USDA Grade A eggs were used in production of this product. Quality control measures plus a 165° F. pasteurization temperature yielded a product that had a negative salmonella count and usually less than 500 bacteria per gram. The product was packed in rigid plastic containers and received no refrigeration. Each one pound net weight package of Product C was the equivalent of three dozen fresh eggs. The primary use of this product was for scrambled eggs but could also be used in omelettes, French toast, casseroles, baked desserts or any recipe that called for fresh eggs. Product C was used in trials 7-10. In trials 7 and 10 the manufacturers' directions for use were followed. In trial 8, a dilution of 3 parts Product C and 1 part fresh egg was compared with Product C. In trial 9, an equal amount of pre-cooked pork sausage was mixed with each sample of the egg melange just before scrambling.

Panel Participants

Four different groups of consumers were used as panel members to evaluate the three products used in this study. In trial 1, 32 members of the Extension Wives Club (Panel A) were used as panel participants. This group was composed of wives of Michigan State University campus based extension specialists. Each participant was a homemaker and did not have prior experience with the product tested. The panel was

conducted as an educational program at one of the regularly scheduled club meetings on April 22, 1966.

The Michigan State University - Wayne State University Consumer Panel (Panel B) was used in trials 2 and 10. Afternoon and evening sessions were recorded separately and then as a composite for each trial. This panel was initiated in 1956 to establish consumer preference among grades, varieties, sizes, color, and processing techniques for agricultural products. According to Marquardt et al. (1963), this panel was designed to determine preferences of consumers with annual incomes ranging from $4,000 to $10,000, of ages 30-45, and with 12 to 13 years of formal education. Consumers for the panel were selected at random from listings in the Detroit, Michigan telephone directory and thus were chosen without regard to ability to differentiate qualities of products. Each panel participant was paid a token amount for his time and effort. Trial 2 was held on May 4, 1966 and trial 10 was held on November 30, 1966. Specific statistics on the panel members were as follows:

		Trial 2	Trial 10
(1) Number of participants		153	160
(2) Percentage women		72.8	77.1
(3) Percentage men		27.2	22.9
(4) Age range	men	31-over 60	31-60
	women	31-over 60	31-over 60
(5) Income range		Under $2,000-over $10,000	Under $2,000-over $10,000
(6) Education range		Under 8-over 14	Under 8-over 14

The third group of panelists (Panel C) were Michigan State University students taking a Food Science Department course entitled "Food Processing I: Physical Principles" and were used for trial 3, May 26, 1966. This group was included in the study because they were being

trained in organoleptic food testing techniques. Specific statistics of the class members were:

(1) Number of participants 14
(2) All were men
(3) Seniors or graduate students

The fourth group of panel members (Panel D) were chosen from the Food Science, Dairy Science, Animal Husbandry, and Poultry Science Departments of Michigan State University. Panel members were grouped as secretaries (homemakers), students, and professional staff. Each group was tested and recorded separately and then as a composite for trials 4 through 9, which were held in the period November 7 through November 28, 1966. Specific statistics of the panel members were:

	Secretaries	Students	Staff
(1) Number participants	14	11	8
(2) Percentage women	100	10	0
(3) Percentage men	0	90	100
(4) Age range	22-58	20-35	35-60
(5) Educational level	through BS	seniors-graduates	through Ph.D.

Bohren and Jordan (1953) stated that after considerable time and effort had been expended, it became obvious that a consistent and reliable scoring panel for dried egg samples could not be developed from the relatively small number of candidates available. Thus, because of limited numbers, panels A, C, and D were used as screening panels as an aid in developing procedures and techniques as well as for evaluating products.

A tabular presentation of the experimental design is provided in Table 7.

Table 7--Tabular presentation of the experimental design

Trial number	Product				Panel			
	A	B	C	Fresh egg	A	B	C	D
1	x			x	x			
2	x			x		x		
3	x			x			x	
4	x	x						x
5		x		x				x
6		x		x				x
7			x	x				x
8			x	x				x
9			x	x				x
10			x	x		x		

Presentation of Samples

A method of scrambling eggs, both from fresh eggs and from egg solids, that would give a true repeatability picture of their consistency, color, flavor, and palatability was necessary. Also, it was necessary that the method lend itself to the preparation of scrambled eggs for a large number of panel participants.

To prepare samples for Official United States Standards for Palatability Scores for Dried Whole Eggs the following procedure shall be followed (U.S.D.A., 1967). Reconstitute 33 grams of dried whole egg powder as completely as possible with 90 grams of distilled water in a 250 to 400 ml. pyrex beaker by adding a third of the water, mixing until smooth and then adding the remainder of the water slowly while stirring.

Place the beaker in gently boiling water and stir the reconstituted egg while coagulation takes place. When coagulated to the consistency of scrambled eggs, the sample is ready for the palatability test. This method proved to be too time consuming for presenting samples to larger numbers of panel members.

A method using stainless steel pans 23 X 40 X 10 cm. placed in a gently boiling water bath was tried. For the purposes of this study, this method proved to be inadequate because sample consistency was not repeatable.

The scrambling of eggs in electric frypans was also tried and evaluated. The results from these tests were inconsistent due, in all probability, to the difference in the settings and readings of the self-contained thermostats.

The method of choice was the use of 25 cm. Teflon-coated fry pans on rheostatically controlled electric heating units. These electric units provided an easily controllable constant source of heat. The Teflon-coated fry pans were quickly and easily cleanable between cookings. The 25 cm. size proved to be adequate for the purposes of this test. Nylon spoons were used to stir the samples while cooking.

Directions of Marquardt (1964) on presenting samples to a panel were followed. All samples were placed in identical containers. The samples were identified by symbols rather than by numbers, letters, or name. The code was such that no implied order was suggested.

A standardized form on which panel members recorded their preference was used and is shown in Appendix A.

To avoid the possibility of a mix-up in the samples, one Teflon-coated fry pan was marked ( ) on the handle, one was marked % and one was marked # -- these marks corresponded to the marks on the test cards. Identical marks were placed on the egg melange containers and on the serving platters.

Before panel members were permitted to enter the room where the samples were, the triangle test, except in trial 3 where a hedonic scale test was used, was explained in detail. Instructions were given on filling out their test cards. No comments were asked for, so those that were given were spontaneous.

Approximately one teaspoon of warm scrambled eggs from each sample was presented to each panel member. These samples were presented on sectional paper plates which had been marked with the test symbols with a wax pencil. Panel members used plastic forks or spoons with which to taste the sample. Salt and pepper were available for those who wanted to use either or both.

Statistical Procedure

Since scrambled fresh eggs were to be compared with scrambled egg solids, an analytical method lending itself to statistical analysis was desirable.

Roessler et al. (1948) stated that the "triangular test" or odd sample method, is useful in comparing two samples which are essentially alike. In this test the taster is served, at the same time, three samples identified only by symbols and is aware that two of the samples are identical, the other different. He is asked two questions: "Which is the odd sample?" and "Which do you prefer, the odd or like sample?"

Since the test is triangular, the probability p of a taster guessing the right sequence is one-third, and the probability q of an incorrect guess is two-thirds. By chance alone the expected numbers of correct answers, therefore, for n tasters would be n/3 and the number of incorrect 2n/3. The standard error of the distribution is $\sqrt{np\ (1-p)}$ which is equal to $\sqrt{2\ n/3}$. If y denotes the observed number of correct answers, then the normal deviate, applying a correction for continuity, would be

$$\frac{y - \frac{n}{3} - 0.5}{\sqrt{\frac{2n}{3}}}$$

at the 0.05, 0.01, and 0.001 levels of significance the values of this ratio are, respectively, 1.960, 2.576, and 3.291. This leads to three proportions for determining the values of y at these three levels of significance:

At the 0.05 level,

$$\frac{y - \frac{n}{3} - 0.5}{\sqrt{\frac{2n}{3}}} = 1.960$$

$$y = \frac{n}{3} + 0.5 + 0.9239\sqrt{n}$$

At the 0.01 level,

$$\frac{y - \frac{n}{3} - 0.5}{\sqrt{\frac{2n}{3}}} = 2.576$$

$$y = \frac{n}{3} + 0.5 + 1.214\sqrt{n}$$

At the 0.001 level,

$$y - \frac{n}{3} - 0.5 = 3.291 \sqrt{\frac{2n}{3}}$$

$$y = \frac{n}{3} + 0.5 + 1.551 \sqrt{n}$$

In Appendix C are tabulated, for various numbers of tests, the number of correct answers, as calculated from the above expressions, at the 0.05, 0.01, and 0.001 levels necessary to establish significant differentiation. Roessler et al. (1956), base their data for Appendix D on cumulative terms of the binomial distribution which indicate the number of agreeing judgements (two-tail) or correct answers (one-tail) required for significance in the triangular (p = 1/6) system, where p is the probability of a correct guess. This is applicable where p = 1/3 for the triangle test and p = 1/2 for the paired test (preference) which means that 1/3 times 1/2 equals 1/6.

For values of n (number of tasters) not in the table, formulas based on the corrected normal-curve approximations to binomial distribution may be used for determining required numbers of agreeing judgements for significance. For n tasters and p = 1/6 the observed number of agreeing judgements (two-tail) or correct answers (one-tail) must exceed

$$\frac{n}{6} + 0.5 + \frac{z \sqrt{5n}}{6}$$

where for the two-tailed test at the 0.05, 0.01, and 0.001 levels of significance the values of z are, respectively, 1.960, 2.576, and 3.291

and for the one-tailed test the values of z are respectively, 1.645, 2.326, and 3.090.

In trial 3 a hedonic scale test for the evaluation of scrambled egg solids was used because of testing procedures used by the class instructor. According to Marquardt (1964), the hedonic scale method of evaluating one sample is a very easy test to construct, explain to panelists, and to analyze. The results from a single product hedonic rating test are usually analyzed by calculating the arithmetic mean of the response for the product. This is done by assigning numerical values to the points on the hedonic scale, Appendix B.

RESULTS AND DISCUSSION

Trial 1

The 32 panel members (Panel A) returned 28 completed-usable-cards. Of these 28 individuals, 22 correctly picked the fresh egg sample as the different sample (Table 8). The differences shown by these data were very highly significant ($P < .001$). Of those correctly picking the different sample, 14 preferred the different sample, the fresh eggs. The differences shown by these data were very highly significant ($P < .001$).

Table 8--Acceptance of Product A, the fortified whole egg solid, by Panel A (Trial 1)

Different Sample (Fresh Eggs) Preference		Identical Sample (Product A) Preference		Identical Sample (Product A) Preference	
Different Sample	14	Different Sample	1	Different Sample	0
Identical Sample	8	Identical Sample	1	Identical Sample	4
Total	22		2		4

Total number of panel members	28
Number of panel members identifying different sample	22[a]
Number of panelists preferring the fresh eggs	14[b]
Number of panelists preferring Product A	8

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

Data from trial 1 showed that in this instance the fresh eggs could be differentiated from Product A and that the panel members definitely preferred the fresh eggs.

Trial 2

The 55 panel members evaluating products during the afternoon session (Panel B) returned 52 completed-usable-cards. The fresh egg sample was correctly picked as the different sample by 28 of these 52 panel members (Table 9). The differences shown by these data were highly significant ($P < .01$). Of those correctly picking the different sample, the fresh eggs, 23 preferred the different sample. The differences shown by these data were very highly significant ($P < .001$).

During the evening session, 98 panel members evaluated products and returned 92 completed-usable-cards. The different sample, the fresh eggs, was picked by 57 of 92 panel members (Table 9). The differences shown by these data were very highly significant ($P < .001$). The different sample, the fresh eggs, was preferred by 49 of those correctly picking the different sample. The differences shown by these data were very highly significant ($P < .001$).

Combined data from the afternoon and evening panels showed that 153 panel members evaluated products and that 144 completed-usable-cards were returned. The fresh egg sample was correctly picked as the different sample by 85 of the 144 individuals (Table 9). Differences shown by these data were very highly significant ($P < .001$). The fresh eggs were preferred by 72 of those correctly picking them as the different sample. Differences shown by these data were very highly significant ($P < .001$).

Table 9--Acceptance of Product A, the fortified whole egg solid, by Panel B (Trial 2)

Different Sample (Fresh Eggs) Preference		Identical Sample (Product A) Preference		Identical Sample (Product A) Preference	
Afternoon					
Different Sample	23	Different Sample	1	Different Sample	1
Identical Sample	5	Identical Sample	19	Identical Sample	3
Total	28		20		4
Evening					
Different Sample	49	Different Sample	3	Different Sample	4
Identical Sample	8	Identical Sample	6	Identical Sample	22
Total	57		9		26
Combining					
Different Sample	72	Different Sample	4	Different Sample	5
Identical Sample	13	Identical Sample	25	Identical Sample	25
Combined Total	85		29		30

Total number of panel members	144
Number of panel members identifying different sample	85[a]
Number of panelists preferring the fresh eggs	72[b]
Number of panelists preferring Product A	13

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

In this trial, 58.53 percent of the men and 59.22 percent of the women correctly picked the different sample, the fresh eggs. The fresh eggs were preferred by 88.52 percent of the women and by 83.33 percent of the men.

Unsolicited comments from the panel members of trial 2 are listed in Appendix E. The most consistent complaint was that Product A, the fortified whole egg was too sweet.

Trial 3

Panel C scored Product A 3.5 out of a possible 7 on a hedonic scale test (Appendix B). This 3.5 score actually amounted to a dislike-slightly rating. The class members downgraded the product because of its sweetness.

Trial 4

Complaints that Product A was too sweet were consistent in the first 3 trials. In an attempt to determine the validity of the complaint of sweetness, a non-fortified whole egg solid of the highest quality obtainable from commercial sources (Product B) was obtained for use in the next series of trials.

In this trial 23 out of 26 panel members (Panel D) correctly picked Product A as the different sample (Table 10). Differences shown by these data were very highly significant ($P < .001$). Product B, the identical sample, was preferred by 14 of those correctly picking Product A as the different sample. Differences shown by these data were very highly significant ($P < .001$).

Table 10--Acceptance of Product A, the fortified whole egg solid, vs. Product B, the whole egg solid, by Panel D (Trial 4)

Identical Sample (Product B) Preference		Different Sample (Product A) Preference		Identical Sample (Product B) Preference	
Student					
Different Sample	0	Different Sample	5	Different Sample	0
Identical Sample	0	Identical Sample	6	Identical Sample	0
Total	0		11		0
Staff					
Different Sample	0	Different Sample	0	Different Sample	0
Identical Sample	0	Identical Sample	5	Identical Sample	0
Total	0		5		0
Secretaries					
Different Sample	0	Different Sample	4	Different Sample	1
Identical Sample	1	Identical Sample	3	Identical Sample	1
Total	1		7		2
Combining					
Different Sample	0	Different Sample	9	Different Sample	1
Identical Sample	1	Identical Sample	14	Identical Sample	1
Grand Total	1		23		2

Total number of panel members	26
Number of panel members identifying different sample	23[a]
Number of panelists preferring Product B	14[b]
Number of panelists preferring Product A	9

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

Panel members in trial 4 experienced no difficulty in distinguishing between Product A and Product B. They expressed a very definite preference for Product B - the whole egg over Product A - the fortified egg.

Trial 5

Without exception in trial 5, panel members picked the fresh eggs as the different sample and without exception they preferred the fresh eggs to Product B. These data are tabulated in Table 11.

Trial 6

In trial 6, 31 of 33 panel members correctly picked the Product B sample as the different sample. All 31 of those correctly picking Product B as the different sample preferred the fresh eggs. Thus, the results in trial 6 tend to confirm those obtained in trial 5. The trial 6 data are tabulated in Table 12.

Trial 7

Panel members returned 33 usable cards for trial 7. Product C was picked as the different sample by 30 out of 33 panel members (Table 13). Differences shown by these data were very highly significant ($P < .001$). The identical samples, the fresh eggs were preferred by 28 panel members over Product C. Differences shown by these data were very highly significant ($P < .001$).

The panel (Panel D) had little trouble distinguishing between Product C and fresh eggs. Fresh eggs were overwhelmingly preferred to Product C. However, the comments on Product C were:

Table 11--Acceptance of Product B, the whole egg solid, by Panel D (Trial 5)

Identical Sample (Product B) Preference		Identical Sample (Product B) Preference		Different Sample (Fresh Eggs) Preference	
Students					
Different Sample	0	Different Sample	0	Different Sample	11
Identical Sample	0	Identical Sample	0	Identical Sample	0
Total	0		0		11
Staff					
Different Sample	0	Different Sample	0	Different Sample	5
Identical Sample	0	Identical Sample	0	Identical Sample	0
Total	0		0		5
Secretaries					
Different Sample	0	Different Sample	0	Different Sample	10
Identical Sample	0	Identical Sample	0	Identical Sample	0
Total	0		0		10
Combining					
Different Sample	0	Different Sample	0	Different Sample	26
Identical Sample	0	Identical Sample	0	Identical Sample	0
Combined Total	0		0		26

Total number of panel members	26
Number of panel members identifying different sample	26[a]
Number of panelists preferring the fresh eggs	26[b]
Number of panelists preferring Product B	0

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

Table 12--Acceptance of Product B, the whole egg solid, by Panel D (Trial 6)

Identical Sample (Fresh Eggs) Preference		Different Sample (Product B) Preference		Identical Sample (Fresh Eggs) Preference	
Students					
Different Sample	0	Different Sample	0	Different Sample	0
Identical Sample	0	Identical Sample	10	Identical Sample	0
Total	0		10		0
Staff					
Different Sample	0	Different Sample	0	Different Sample	1
Identical Sample	0	Identical Sample	8	Identical Sample	0
Total	0		8		1
Secretaries					
Different Sample	1	Different Sample	0	Different Sample	0
Identical Sample	0	Identical Sample	13	Identical Sample	0
Total	1		13		0
Combining					
Different Sample	1	Different Sample	0	Different Sample	1
Identical Sample	0	Identical Sample	31	Identical Sample	0
Combined Total	1		31		1

Total number of panel members	33
Number of panel members identifying different sample	31[a]
Number of panel members preferring the fresh egg	31[b]
Number of panel members preferring Product B	0

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

Table 13--Acceptance of Product C, a patented egg product, by Panel D (Trial 7)

Identical Sample (Fresh Eggs) Preference		Identical Sample (Fresh Eggs) Preference		Different Sample (Product C) Preference	
Students					
Different Sample	0	Different Sample	0	Different Sample	1
Identical Sample	0	Identical Sample	0	Identical Sample	9
Total	0		0		10
Staff					
Different Sample	1	Different Sample	0	Different Sample	0
Identical Sample	0	Identical Sample	0	Identical Sample	8
Total	1		0		8
Secretaries					
Different Sample	1	Different Sample	0	Different Sample	1
Identical Sample	0	Identical Sample	1	Identical Sample	11
Total	1		1		12
Combining					
Different Sample	2	Different Sample	0	Different Sample	2
Identical Sample	0	Identical Sample	1	Identical Sample	28
Combined Total	2		1		30

Total number of panel members	33
Number of panel members identifying different sample	30[a]
Number of panelists preferring the fresh eggs	28[b]
Number of panelists preferring Product C	2

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

(1) Really nice flavor.

(2) Different sample is improved.

(3) Improved in consistency and flavor.

(4) Bland-taste dry.

(5) Texture better.

(6) Samples were more identical in appearance and texture.

(7) I'm inclined to like it.

(8) It's improving.

(9) All samples very good.

(10) Preference not so strong as before.

(11) Like the different sample.

(12) All have equally good texture.

Trial 8

Of the 31 panel members returning usable cards, only 14 determined that the dilution was the different sample. Differences in these data showed no significance. However, 13 of those properly differentiating the different sample preferred diluted Product C and this was highly significant ($P < .01$).

When the data presented in Table 14 were studied it appeared that the secretaries were able to identify the fresh egg taste more accurately than either the students or staff members.

Trial 9

In trial 9, 31 usable cards were returned. The fresh egg-sausage sample was correctly picked as the different sample by 23 out of 31 individuals (Table 15). Differences shown by these data were very

Table 14--Effect of diluting Product C, a patented egg product, with fresh eggs and acceptance by Panel D (Trial 8)

Different Sample (Diluted Product C) Preference		Identical Sample (Product C) Preference		Identical Sample (Product C) Preference	
Students					
Different Sample	2	Different Sample	3	Different Sample	1
Identical Sample	1	Identical Sample	1	Identical Sample	3
Total	3		4		4
Staff					
Different Sample	3	Different Sample	0	Different Sample	0
Identical Sample	0	Identical Sample	3	Identical Sample	0
Total	3		3		0
Secretaries					
Different Sample	8	Different Sample	1	Different Sample	0
Identical Sample	0	Identical Sample	3	Identical Sample	2
Total	8		4		2
Combining					
Different Sample	13	Different Sample	4	Different Sample	1
Identical Sample	1	Identical Sample	7	Identical Sample	5
Combined Total	14		11		6

Total number of panel members	31
Number of panel members identifying the different sample	14
Number of panelists preferring the dilution	13[a]
Number of panelists preferring Product C	1

[a]Significant preference ($P < .01$).

Table 15--Effect of the addition of sausage to Product C, a patented egg product, and acceptance by Panel D (Trial 9)

Different Sample (Fresh Eggs-Sausage)		Identical Sample (Product C - Sausage)		Identical Sample (Product C - Sausage)	
Preference		Preference		Preference	
Students					
Different Sample	5	Different Sample	0	Different Sample	0
Identical Sample	2	Identical Sample	2	Identical Sample	2
Total	7		2		2
Staff					
Different Sample	0	Different Sample	1	Different Sample	0
Identical Sample	5	Identical Sample	0	Identical Sample	0
Total	5		1		0
Secretaries					
Different Sample	6	Different Sample	0	Different Sample	1
Identical Sample	5	Identical Sample	2	Identical Sample	0
Total	11		2		1
Combining					
Different Sample	11	Different Sample	1	Different Sample	1
Identical Sample	12	Identical Sample	4	Identical Sample	2
Combined Total	23		5		3

Total number of panel members	31
Number of panel members identifying the different sample	23[a]
Number of panelists preferring Product C - Sausage	12[b]
Number of panelists preferring the Fresh Eggs-Sausage	11

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .01$).

highly significant ($P < .001$). The Product C-sausage sample was preferred by 12 of those properly differentiating the different sample. Differences shown by these data were highly significant ($P < .01$).

Panel members picked the different sample, fresh eggs-sausage, without too much trouble. Of those who could tell the difference between the samples, 52.2 percent preferred the Product C-sausage sample to the fresh egg-sausage sample.

Trial 10

At the afternoon session (Panel B), 66 usable cards were returned. The fresh eggs were correctly picked as the different sample by 38 individuals (Table 16). Differences shown by these data were very highly significant ($P < .001$). Product C was preferred by 27 of those properly differentiating the different sample and this was very highly significant ($P < .001$).

At the evening session, 89 completed-usable-cards were returned. Product C was correctly picked as the different sample by 76 out of 89 individuals. This was very highly significant ($P < .001$). Fresh eggs were preferred by 44 of those properly differentiating the different sample. This was very highly significant ($P < .001$).

When the data from the afternoon and evening panels were combined, 114 out of 155 individuals correctly picked the different sample. This was very highly significant ($P < .001$). On a percentage basis, 76.31 percent of the women and 65.85 percent of the men properly picked the odd sample. Product C was preferred by 59 of those properly differentiating the different sample. This was very highly significant

Table 16--Acceptance of Product C, a patented egg product, by Panel B (Trial 10)

Afternoon Panel

Identical Sample (Product C) Preference		Identical Sample (Product C) Preference		Different Sample (Fresh Eggs) Preference	
Different Sample	6	Different Sample	10	Different Sample	11
Identical Sample	3	Identical Sample	9	Identical Sample	27
Total	9		19		38

Evening Panel

Identical Sample (Fresh Eggs)		Identical Sample (Fresh Eggs)		Different Sample (Product C)	
Different Sample	5	Different Sample	0	Different Sample	32
Identical Sample	3	Identical Sample	5	Identical Sample	44
Total	8		5		76

Combining Preferences

	Product C	Fresh Eggs
Afternoon	27	11
Evening	32	44
Total	59	55

Total number of panel members	155
Number of panel members identifying different sample	114[a]
Number of panelists preferring Product C	59[b]
Number of panelists preferring the fresh eggs	55

[a]Significant differentiation ($P < .001$).

[b]Significant preference ($P < .001$).

($P < .001$). Product C was preferred by 52.87 percent of the women and by only 48.15 of the men. The combined average was a 51.75 percent preference for Product C. On the basis of the data obtained in trial 10, Product C was preferred to fresh eggs.

General Discussion

Pilley (1966) stated that Product A, a fortified whole egg solid, was perhaps the largest seller of egg solids to schools and institutions and that the small addition of syrup as used for the purposes outlined was necessary and had certainly been well accepted. Panelists on this research problem complained about the sweetness of this product when used for scrambling purposes. Data from this experiment indicates that consumers would reject this product for scrambling purposes.

Product B, a high quality commercially available whole egg solid, was preferred by the panel members to Product A. However, when Product B was compared with fresh eggs, panelists were 100 percent in their preference for the fresh eggs. Some of the comments concerning Product B were almost a repeat of those complaints heard during World War II: "texture not good", "slightly rancid", "flavor poor", "strong", "Ugh", "tastes like dried eggs".

Product C, the patented egg product, was used in trials 7, 8, and 9 and evaluated by Panel D. According to these panel members, this new product was very good. It was almost identical in color, flavor, texture, appearance, and consistency with fresh eggs. Panel B, in trial 10, had even more trouble than Panel D in differentiating between the patented egg product and fresh eggs. Graduate students could not

tell the difference between the two products while cooking the samples and then serving panel members.

Halverson (1967) indicates that by 1975 between 13 and 30 percent of all eggs consumed will be in the form of egg products. Dunk (1967) requests that we not let our capacity to produce egg products outstrip our ability to find a profitable market for these products. The results of the tests carried out in this experiment indicate that egg solid products that are commercially available can be used to replace fresh eggs for scrambling purposes. The manufacturing and marketing of egg solids comparable to Product C could answer the question raised by Dunk (1967) and make the statement of Halverson (1967) come true.

Despite statistical differences observed markets may be available for each of the products studied because 6 of 28 individuals in trial 1, 59 of 144 in trial 2, 3 of 26 in trial 4, 2 of 33 in trial 6, 3 of 30 in trial 7, 17 of 31 in trial 8, 8 of 31 in trial 9, and 41 of 155 in trial 10 could not identify the difference between products.

Differences in age, education, sex, and income did not statistically influence the results obtained.

SUMMARY

Data from trials 1 and 2 indicated ($P < .001$) that the fresh eggs were preferred to Product A, a fortified whole egg product. Numerous complaints were made that these egg solids were too sweet. Data from trial 3, a Hedonic-Scale Test, showed a dislike-slightly rating. Down-grading was due partially to the sweetness.

Data from trial 4 showed that panelists had a very definite preference ($P < .001$) for non-fortified whole egg solids Product B when compared with fortified whole egg solids Product A.

Data from trials 5 and 6, in which fresh eggs were compared with non-fortified whole egg solids (Product B), showed that panel members were unanimous in their preference of fresh eggs.

In trial 7, fresh eggs were preferred to Product C, a patented egg product. The panel indicated that Product C was good but that they preferred fresh eggs.

Data from trial 8 showed that the panelists preferred Product C diluted with fresh eggs over straight Product C.

Even though sausage was used in trial 9 to mask the egg flavor, the panel showed a preference for Product C over fresh eggs.

The consumer panel used in trial 10 significantly differentiated ($P < .001$) between fresh eggs and Product C. Those that could tell the difference between the samples presented, preferred Product C.

CONCLUSIONS

The triangle method of sample presentation was used to determine consumer preferences between scrambled fresh eggs and scrambled egg solids. The results from the ten trials of this experiment indicate that:

1. Fortified whole egg solids (containing 8% corn syrup before drying) were too sweet to be readily acceptable to consumers for scrambling purposes when fresh eggs were available.

2. Whole egg solids (a non-fortified whole egg solid) were preferred to fortified whole egg solids for scrambling purposes.

3. Fresh eggs scrambled were definitely preferred to scrambled whole egg solids.

4. A patented egg product was preferred to fresh eggs.

Thus it appears that the patented egg product will compare favorably with fresh eggs as to odor, texture, palatability, and cost for scrambling purposes.

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APPENDICES

APPENDIX A

SAMPLE TRIANGLE TEST RECORD CARD

TRIANGLE TEST

NAME_____ DATE_____

TEST_____

1. Two of these samples are identical, and one is different. Taste the 3 samples, then check below the <u>different</u> sample.

( ) _____

% _____

_____

2. Please check which you prefer:

Different sample _____

Identical sample _____

Comments:

APPENDIX B

SAMPLE HEDONIC SCALE RECORD CARD

Preference Test

Name: _____ Date: _____

Sample No:	_____	_____	_____	_____
7	Like Extremely	Like Extremely	Like Extremely	Like Extremely
6	Like Very much	Like Very much	Like Very much	Like Very much
5	Like Slightly	Like Slightly	Like Slightly	Like Slightly
4	Neither like Nor dislike	Neither like Nor dislike	Neither like Nor dislike	Neither like Nor dislike
3	Dislike Slightly	Dislike Slightly	Dislike Slightly	Dislike Slightly
2	Dislike Very much	Dislike Very much	Dislike Very much	Dislike Very much
1	Dislike Extremely	Dislike Extremely	Dislike Extremely	Dislike Extremely

. . . . . .

PLEASE CHECK ONE OF THE FOLLOWING:

Standard	Standard	Standard	Standard
Void	Void	Void	Void
Foreign	Foreign	Foreign	Foreign
Accept	Accept	Accept	Accept
Reject	Reject	Reject	Reject

APPENDIX C

PROBABILITY IN TRIANGULAR TASTE TESTS

No. of tasters or tastings	No. of correct answers necessary to establish significant differentiation			No. of tasters or tastings	No. of correct answers necessary to establish significant differentiation		
	P=0.05	P=0.01	P=0.001		P=0.05	P=0.01	P=0.001
7	5	6	7	57	27	29	31
8	6	7	8	58	27	29	32
9	6	7	8	59	27	30	32
10	7	8	9	60	28	30	33
11	7	8	9	61	28	30	33
12	8	9	10	62	28	31	33
13	8	9	10	63	29	31	34
14	9	10	11	64	29	32	34
15	9	10	12	65	30	32	35
16	10	11	12	66	30	32	35
17	10	11	13	67	30	33	36
18	10	12	13	68	31	33	36
19	11	12	14	69	31	34	36
20	11	13	14	70	32	34	37
21	12	13	15	71	32	34	37
22	12	14	15	72	32	35	38
23	13	14	16	73	33	35	38
24	13	14	16	74	33	36	39
25	13	15	17	75	34	36	39
26	14	15	17	76	34	36	39
27	14	16	18	77	34	37	40
28	15	16	18	78	35	37	40
29	15	17	19	79	35	38	41
30	16	17	19	80	35	38	41
31	16	18	19	81	36	38	41
32	16	18	20	82	36	39	42
33	17	19	20	83	37	39	42
34	17	19	21	84	37	40	43
35	18	19	21	85	37	40	43
36	18	20	22	86	38	40	44
37	18	20	22	87	38	41	44
38	19	21	23	88	39	41	44
39	19	21	23	89	39	42	45
40	20	22	24	90	39	42	45
41	20	22	24	91	40	42	46
42	21	22	25	92	40	43	46
43	21	23	25	93	40	43	46
44	21	23	25	94	41	44	47
45	22	24	26	95	41	44	47
46	22	24	26	96	42	44	48
47	23	25	27	97	42	45	48
48	23	25	27	98	42	45	49
49	23	25	28	99	43	46	49
50	24	26	28	100	43	46	49
51	24	26	29	200	80	84	89
52	25	27	29	300	117	122	127
53	25	27	29	400	152	158	165
54	25	27	30	500	188	194	202
55	26	28	30	1,000	363	372	383
56	26	28	31	2.000	709	722	737

APPENDIX D

SIGNIFICANCE IN TRIANGULAR TASTE TESTS (p = 1/6)

No. of tasters or tastings	Minimum agreeing judgments necessary to establish significant differentiation (Two-tail test)			Minimum correct answers necessary to establish significant differentiation (One-tail test)		
	P=0.05	P=0.01	P=0.001	P=0.05	P=0.01	P=0.001
5	4	4	5	3	4	5
6	4	5	6	4	4	5
7	4	5	6	4	5	6
8	5	5	6	4	5	6
9	5	6	7	4	5	7
10	5	6	7	5	6	7
11	5	6	8	5	6	7
12	6	7	8	5	6	8
13	6	7	8	5	7	8
14	6	7	9	6	7	8
15	7	8	9	6	7	9
16	7	8	9	6	7	9
17	7	8	10	7	8	9
18	7	9	10	7	8	10
19	8	9	10	7	8	10
20	8	9	11	7	9	10
21	8	9	11	7	9	10
22	8	10	11	8	9	11
23	9	10	12	8	9	11
24	9	10	12	8	10	11
25	9	10	12	8	10	12
26	9	11	12	9	10	12
27	10	11	13	9	10	12
28	10	11	13	9	11	12
29	10	12	13	9	11	13
30	10	12	14	10	11	13
31	11	12	14	10	11	13
32	11	12	14	10	12	13
33	11	13	14	10	12	14
34	11	13	15	10	12	14
35	11	13	15	11	12	14
36	11	13	15	11	13	15
37	12	14	16	11	13	15
38	12	14	16	11	13	15
39	12	14	16	12	13	15
40	13	14	16	12	14	16
41	13	15	17	12	14	16
42	13	15	17	12	14	16
43	13	15	17	12	14	17
44	13	15	17	13	15	17
45	14	15	18	13	15	17
46	14	16	18	13	15	17
47	14	16	18	13	15	18
48	14	16	18	14	15	18
49	15	16	19	14	16	18
50	15	16	19	14	16	18
60	17	19	21	16	18	21
70	19	21	24	18	21	23
80	21	24	26	20	23	26
90	23	26	29	22	25	28
100	26	28	31	24	27	30

APPENDIX E

UNSOLICITED COMMENTS FROM

PANEL B (Trial 2)

Afternoon

Panel Member Number	Sample Picked as Different	Preference	Comments
6	( )	Identical	Very Good!
13	( )	Different	My first impression of the identical samples were of powdered eggs.
17	%	Identical	Didn't like any but identical seemed better.
18	( )	Different	The different sample tastes like real eggs. Other two tastes like powdered eggs.
25	( )	Different	Different sample tastes more natural.
29	( )	Different	I didn't like any of the samples too well.
30	( )	Different	The identical taste sweet.
31	( )	Different	Didn't think the other two tasted very good.
33	( )	Different	Identical samples too sweet.
38	( )	Different	It really didn't taste too much like scrambled eggs!
44	( )	Different	Different sample very good.
47	( )	Different	Sure glad I need not eat the identical samples always!

Panel Member Number	Sample Picked as Different	Preference	Comments
48	( )	Different	Identical tasted sweet.
52	%	None	Taste like it was fried in fish oil.

( ) was the different sample - Fresh Eggs

% and # were identical samples - Product A

APPENDIX F

UNSOLICITED COMMENTS FROM

PANEL B (Trial 2)

Evening

Panel Member Number	Sample Picked as Different	Preference	Comments
57	( )	Different	Identical are too sweet.
66	( )	Different	Identical Ugh!
76	( )	Different	Both taste lousy.
84	( )	Identical	Different has salt on.
85	#	Identical	Seems to be sweeter tasting.
90	%	Identical	Very good.
91	%		Could be same egg with seasoning added.
98	( )	Different	Eggs are my favorite breakfast.
106	( )	Either	I eat them all unless they are absolutely putrid.
115	( )	Different	The identical samples are terribly terrible.
118	( )	Different	Could taste sweetness and oil of some kind.
126	( )	Different	Others have a sweet taste.
127	( )	Different	Tastes natural.
132	#	Identical	Both are palatable.
134	( )	Different	Different samples have sweet taste.

Panel Member Number	Sample Picked as Different	Preference	Comments
138	( )	Different	The identical samples seemed to have too sweet a flavor that spoiled the taste.
141	#	Identical	Different sample has bitter-tarty taste.
142	%	Identical	I like the identical taste better. The other tastes sort of sweet or something added to it.
144	( )	Different	The identical samples were too sweet tasting.
145	%	Different	Very good.
150	( )	Different	Different sample is more flavorable - others are very flat and tasteless.
152	( )	Different	Identical samples are too doughie and much perfume.
153	( )	Identical	Sweet! Good! I've never tasted a "sweet" egg before so usually eat scrambled eggs with jelly!

( ) was the different sample - Fresh Eggs

% and # were identical samples - Product A

APPENDIX G

UNSOLICITED COMMENTS FROM

PANEL B (Trial 10)

Afternoon

Panel Member Number	Sample Picked as Different	Preference	Comments
3	#	Different	Taste the most like real eggs.
20	%	Identical	Identical samples tastier.
21	#	Different	Others tasted as if something were added.
24	( )	Different	Different sample had salt in it.
26	#	Identical	Was somewhat colder than other two. Maybe that made it seem different.
31	#	Identical	Tasted like they had cheese added to them.
34	( )	Identical	Different sample tasted like dried first.
36	%	Identical	They are very close in flavor.
40	#	Identical	The different sample has an odd taste - as it would be with dried eggs.
44	%	Different	They all taste pretty well.
47	( )	Identical	My eyes told me one thing. My tongue another. I'm still not real real sure. To be honest couldn't tell that much. Both weren't the very best.
50	%	Different	All too sweet.

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Panel Member Number			
3			eal eggs.
20			tier.
21			omething
24			salt in
26	#	Identical	Was somewhat colder than other two. Maybe that made it seem different.
31	#	Identical	Tasted like they had cheese added to them.
34	( )	Identical	Different sample tasted like dried first.
36	%	Identical	They are very close in flavor.
40	#	Identical	The different sample has an odd taste - as it would be with dried eggs.
44	%	Different	They all taste pretty well.
47	( )	Identical	My eyes told me one thing. My tongue another. I'm still not real real sure. To be honest couldn't tell that much. Both weren't the very best.
50	%	Different	All too sweet.

Panel Member Number	Sample Picked as Different	Preference	Comments
55	%	Identical	The identical tastes fresher.
57	%	Different	Very good! If I prepared eggs like that my family would eat them. What's your secret?
64	#	Identical	The identical samples didn't seem to have that flat taste.
65	#	Different	Different is sweet - like but good. Identical - Good I'd say.
67	#	Identical	Very good flavor.

was the different sample - Fresh Eggs

( ) and % were identical samples - Product C

APPENDIX H

UNSOLICITED COMMENTS FROM

PANEL B (Trial 10)

Evening

Panel Member Number	Sample Picked as Different	Preference	Comments
70	#	Identical	One tasted powdery.
71	#	Different	It tastes with cheese. I put cheese into my eggs.
74	#	Different	Better flavor.
79	#	Identical	Don't care for taste - not "eggy".
83	#	Identical	A distinct difference.
90	#	Different	Tastes like an egg. Just right.
96	#	Identical	What is the tangy taste of <u>different</u> sample?
99	#	Different	No salt.
100	#	Different	# Has better flavor.
107	#	Identical	Drier.
110	( )		Prefer both.
116	#	Different	Seems to be tastier.
120	#	Identical	Different sample has different texture. Almost too mush and airy.
123	#	Different	One tastes a little bit light and airy.

Panel Member Number	Sample Picked as Different	Preference	Comments
127	#	Identical	Too much milk. Takes away the egg taste.
129	#	Different	The identical ones are dryer and not salty which to my opinion accounts for the difference.
131	#	Identical	Very obvious.
133	#	Different	The different sample seems to have a sweeter flavor.
135	#	Identical	The different one was too watery and bland.
136	#	Identical	I like both tho.
138	#	Identical	The different one seemed powder like in texture.
141	%	Identical	Not much difference in the taste of any samples.

was the different sample - Product C

( ) and % were identical samples - Fresh Eggs