

Dairy Foods

“WHEYFERS”: A High Protein Snack Food Made from Yeast, *Kluyveromyces fragilis*.

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Story in Brief

A high protein snack food called “Cowboy Wheyfers” was developed. These “snack foods” contain more than three times as much protein, less carbohydrate and less fat than similar products available on the market. A taste panel of OSU students compared Wheyfers to commercial snack foods. Results showed the Wheyfers had an acceptable taste.

Introduction and Literature Review

The Environmental Protection Agency (EPA) has recently written restrictions on dairy plant wastes such that it will no longer be possible to pump whey, a by-product of cheese production, down drains and into local sewage treatment facilities. This is primarily because of its high Biological Oxygen Demand (BOD), resulting from the large amounts of the milk sugar (lactose) in the whey. These EPA restrictions have led dairy researchers to explore new methods for whey utilization and BOD reduction. One apparent solution to these problems is the growth of a yeast, *Kluyveromyces fragilis*, in the whey. This yeast converts milk sugar into a valuable single-cell protein (SCP) and reduces the BOD of the remaining liquid.

The production of SCP by growing microorganisms on industrial by-products such as sulfite liquor, hydrocarbons, and whey is fast becoming an industry of its own. This protein has already made its way into animal feeds but its incorporation into human foods is virtually a new frontier for the food scientist. Presently only a low calorie salad dressing has appeared on the supermarket shelves, listing on its label a torula yeast grown on petroleum. However, some authors state that 25-30 new meat and bakery products containing SCP will appear in the marketplace

by the end of 1976. Protein fortification of food is not uncommon. Soy and fish proteins have been used in foods but the inexpensive unlimited supply of substrates for SCP give it a definite advantage. Some nutritionists say that it is expected to play an important role in the world food situation.

A look at today's supermarket shelves will reveal row after row of "snack foods" potato chips, corn chips, pretzels, crackers, etc., in a multitude of shapes and flavors to tempt the tastebuds of consumers, but a closer look at the label will reveal that most of their calories are provided by carbohydrates and fats with very few from protein. Yet these snack foods fill grocery carts and empty the wallets of Americans "to the tune" of millions of dollars each year. Nutritionally, these well-liked snack foods would benefit from a protein supplement. The popularity of snack foods reaches its peak among teens who are one of the most poorly nourished segments of our society. Their diets usually are deficient in protein as well as in other nutrients. Improving their diets through foods they enjoy would be a logical path to follow since changing food habits at this age is close to impossible. This situation supplied the incentive for research to develop a snack food supplement with SCP supplied by *K. fragilis* yeasts. A taste panel determined the acceptability of these "wheyfers" in comparison to snack foods already on the market.

Experimental Methods

Whey-grown *K. fragilis* yeast supplied the product base. This paste-like yeast material was weighed and placed in a mixing bowl. Next the corn starch, egg white, and salt were weighed, added, and the mixture beaten with an electric mixer until it appeared smooth. At this point other solid ingredients were added and mixed until the final dough had a soft clay-like consistency. Half of this dough was then rolled between sheets of waxed paper to the desired thickness and cut into crescent and elliptical shapes. The second half of the dough was extruded through a die resulting in a narrow ribbon-shaped product. The doughs then were fried in liquid cooking oil until slightly brown, then cooked in an oven to remove additional moisture, improving the product's crispness. The finished products, called "Cowboy Wheyfers," were then sealed in clear plastic pouches. Two commercial products with shapes similar to those of the Wheyfers also were packaged in pouches to be sampled along with the Wheyfers.

The taste panel consisted of 12 college students enrolled in a Food and Nutrition "experimental cookery" class. Each panelist received eight packages of coded samples to be tasted in a previously randomized order. The first four of these samples consisted of a rolled Wheyfer, an extruded

Wheyfer and one package of each commercial product. The second four samples were duplicates of the first four, but presented to the judges in a different order. The taste panel evaluated the products approximately 24 hours after packaging. The judges were seated at tables and separated from each other by partitions. Water was provided and instructions were given the panel in both oral and written form. Each sample was scored on a scale of 1-5 (Table 1). Taste panel evaluations were conducted once a week for eight weeks.

Results and Discussion

At first glance, the averages in Table 2 may appear different, with the circular commercial chips being preferred. However, statistical analysis of the data averages showed no difference among products or among judges ($P > 0.05$). Most of the individual data, as well as the averages, were close to three - the value associated with acceptability. Composition analysis showed that Wheyfers contain less fat, less carbohydrate, and more than three times as much protein as the commercial products used in the study.

In food product development the consumer is the ultimate test for acceptability. Obviously the opinions of the 12 panelists are not a cross

Table 1. Example of score sheet used by taste panel judges

JUDGE Name _____ DATE _____

EXPLANATION: Both commercial and experimental snack foods (i.e., Wheyfers) have been packaged for you to sample. The experimental foods have an elevated protein content.

DIRECTIONS: Grade each product by itself using the scale of 1-5 listed below. Assume prices of all products equal. (Products can have the same grade).

PROCEDURE:

- Taste sample and allow some time (approximately 30 seconds) before scoring (in case of an aftertaste).
- Rinse mouth with water and when ready, proceed to next sample.

Sample slowly and thoughtfully. Keep in mind there is no "right" answer and that each individual's samples are different.

- 1 — **EXCELLENT** — Like very much, would buy and eat regularly.
- 2 — **GOOD** — Like, would buy and eat often.
- 3 — **ACCEPTABLE** — Neither like nor dislike, would buy.
- 4 — **POOR** — Dislike, would only buy and eat if no similar product available.
- 5 — **NOT EDIBLE** — Would not buy or eat.

Tasting ² Period	Wheyfers		Commercial Snack Products		
	Ribbon	Elipse	Ribbon	Circular	
A	1	2.95	3.95	2.66	2.70
	2	3.20	3.54	3.25	2.40
	3	3.33	3.16	3.00	2.50
	4	3.08	2.95	2.62	1.95

B	5	2.95	3.12	2.75	2.87
	6	3.42	3.33	2.50	1.88
	7	3.68	3.31	3.28	1.95
	8	3.72	4.05	2.11	1.77
Average of 8 trials		3.29	3.43	2.77	2.25

¹Average of all 12 judges tasting 8 times in duplicate.

²Baking Powder was added to the dough in tasting periods B (5-8), but not in tasting periods A (1-4).



Figure 1. Laurel Dieken preparing Wheyfer dough.

section of consumers and additional evaluations would be needed to provide information about the product's reception in commercial markets. The overall acceptability of the product and its nutritional profile illustrate its merit and suggest that further testing and modification could result in the replacement of the present nutritionally inadequate "snack foods" with more balanced and worthwhile products.

Amino Acid Composition of *Kluyveromyces fragilis* Grown on Cottage Cheese Whey

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Introduction

In previous work from this laboratory it was shown that the yeast *Kluyveromyces fragilis* could be grown on cottage cheese whey, changing the whey sugar (lactose) into a material which was primarily protein. After fermentation the solids could be removed by filtration. The liquid (93% of the original whey volume) had 82% of its chemical oxygen demand (COD) removed after 10-11 hours of fermentation and more than 90% of the COD removed after 24 hours of fermentation. COD is a measure of solid materials which are objectionable in city sewage facilities and streams. Thus fermentation reduced the undesirable solids in the liquid portion of the whey to an acceptable level for disposal.

Handling the remaining seven % solids was the next step. This solid material, or yeast paste, after drying contains 72% protein, 5% ash (minerals), 5% water, and 18% other materials-primarily long chain carbohydrates and fiber in the cell walls of the yeast. The protein material equaled approximately 9% whey proteins and 91% yeast protein. Since this material could be used either in animal feeds or human foods, its amino acid content was of interest. A fairly complete amino acid analysis of *K. fragilis* was conducted in 1961 by Wasserman. However, that study was done fourteen years ago, and the methods used to produce the OSU yeast were somewhat different than those employed by Wasserman. Many