

CHARACTERISTICS OF LOWFAT MOZZARELLA CHEESE

THE FOOD & NUTRITION SERVICE (FNS) will soon be required to lower the fat content of meals served in the National School Lunch Program (NSLP). A school lunch will be limited to 30% of calories from fat, but pizza, one of the most popular entrees, does not meet the requirement because of the Mozzarella cheese topping. An all-natural Mozzarella cheese containing less than 10% fat can be made so that its texture, meltability, and flavor are comparable to those of Mozzarellas containing at least 17% fat. Changes in the manufacturing procedure result in a cheese that is softer and more meltable than other reduced-fat Mozzarellas. Pizzas topped with this lowfat cheese meet the dietary guidelines and have been eagerly accepted in trials in public schools.

The cheese is made with a starter culture typically used for Mozzarella (50% *Streptococcus thermophilus*, 50% *Lactobacillus bulgaricus*) along with a specific strain of *Lactobacillus casei* to enhance the flavor. Following the addition of calf rennet, the curd is held at the relatively low temperature of 36°C so that a higher level of moisture can be retained. The whey is drained and cheddared and then stretched at 80°C or less to prevent the enzymes from being thermally inactivated. The cheese is stored at 4°C for up to 6 wk; during this time a portion of the α_{11} -casein matrix is proteolyzed by the remaining enzymes.

Proteolysis produces several desired effects in the lowfat Mozzarella. Electrophoretic analyses during the storage period (Fig. 1, Table 1) reveal that a significant portion of the α_{11} -casein is broken down to α_{11} -I-casein and other peptides, which soften the structure of the cheese. Electron micrographs (Fig. 2) confirm that the protein matrix becomes less dense, and that the fat globules tend to coalesce. These changes in the microstructure of the cheese lead to a reduction in its hardness and an

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TABLE 1--Casein breakdown during Mozzarella storage
(% of total casein)

Wk	α_{22}	α_{11}	α_{11} -I	β	Peptides
Lowfat					
1	11.9	31.8	2.3	35.1	19.0
6	8.6	6.5	30.7	30.9	23.4
Full Fat					
1	12.2	30.3	8.0	35.6	14.0
6	11.8	9.3	18.7	29.6	30.7

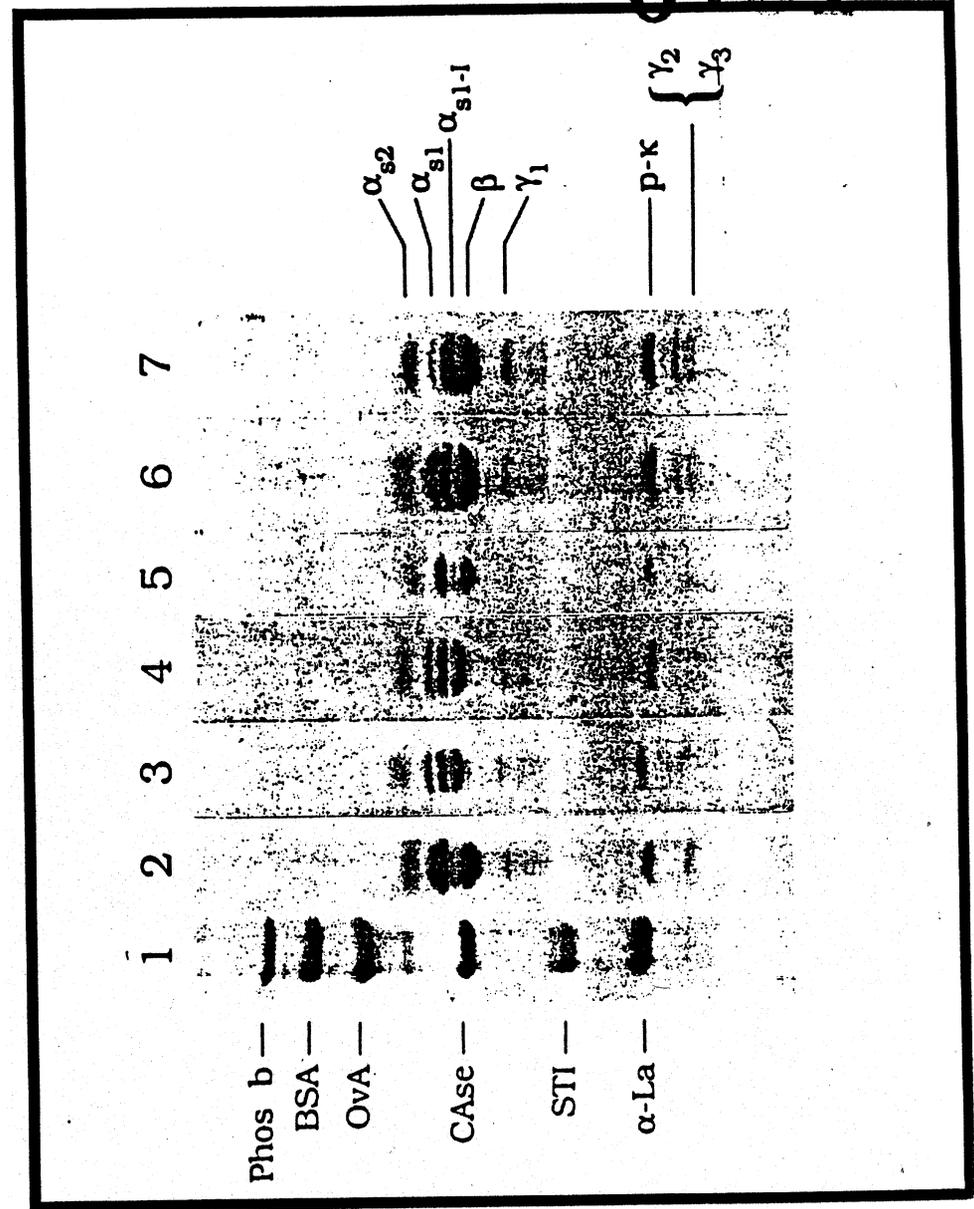


FIG. 1--Polyacrylamide gel electrophoresis of lowfat and full fat Mozzarella cheese. Lane 1: protein standards (); lane 2: lowfat Mozzarella, 1 wk storage; lane 3: lowfat, 3 wk; lane 4: lowfat, 6 wk; lane 5: full fat, 1 wk; lane 6: full fat, 3 wk; lane 7: full fat, 6 wk. The formation from α_{11} -casein of the peptides α_{11} -I-casein and γ_1 -, γ_2 -, and γ_3 -casein, increased with storage time. The amounts of α_{22} -, β -, and para- κ -casein remained relatively constant.

increase in its meltability, two factors which are not always addressed when the manufacture of reduced-fat Mozzarella is attempted.

Hardness, as determined by texture profile analysis, and meltability, as measured by the Schreiber test, are both dependent on moisture in nonfat substance (MNFS). MNFS is basically a ratio of water to protein and is determined by subtracting percentage of fat from 100 and then dividing into percentage of water. Hardness decreases with storage time, fat content, and MNFS (Fig. 3). Meltability, which is a measure of the expansion of a disk of melted cheese, increases with the above parameters (Fig. 4). If lowfat Mozzarella is stored for 6 wk and the MNFS is high enough, its hardness and meltability will be comparable to those of fresh full-fat Mozzarella.

By 1998, nutritional standards for lunches served in the NSLP must incorporate the Dietary Guidelines for Americans. The composition of the lowfat Mozzarella developed at ARS (Table 2) attracted the interest of FNS, which arranged for the testing of pizzas topped with this cheese at various schools located across the country. The cheese used for these trials was manufactured at three industrial plants over the past 20 mo. In the most recent tests, pizzas were prepared on site from refrigerated ingredients. In the earlier tests, 5-oz (140 g) frozen pizzas containing at least 1 oz of lowfat Mozzarella were manufactured commercially. The students liked the texture and flavor

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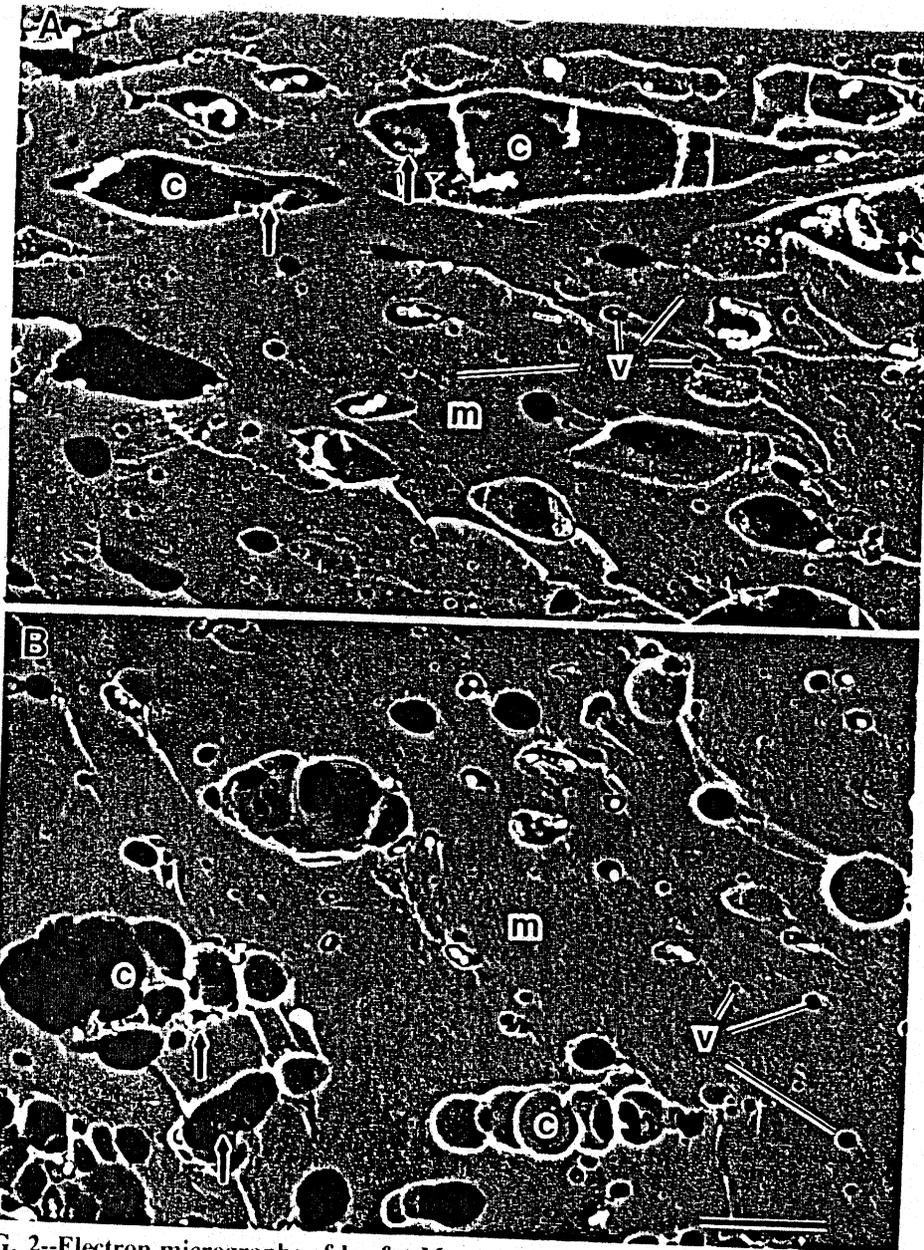


FIG. 2--Electron micrographs of lowfat Mozzarella cheese after 1 wk storage (top) and 6 wk storage (bottom). Arrows point to starter culture bacteria, protein matrix is indicated by m, cavities occupied by fat globules are indicated by c, and vesicles occupied by smaller globules are indicated by v. Bar at lower right is 10 μ m.

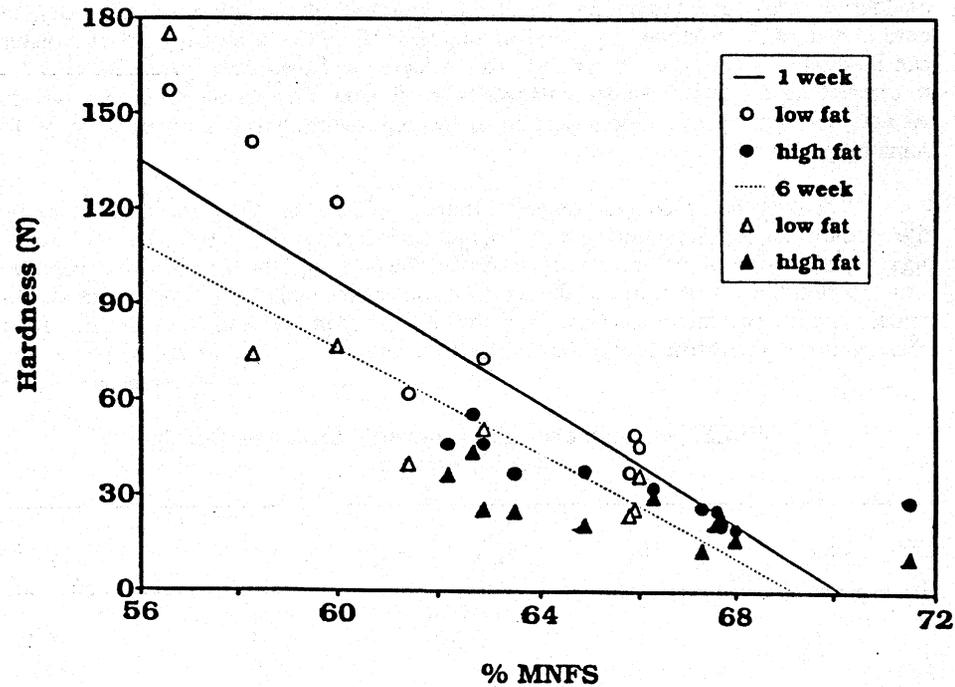


FIG. 3--Hardness in newtons vs percentage of moisture in nonfat substance (MNFS) in lowfat and full fat Mozzarella cheeses.

TABLE 2—Compositional analysis of Mozzarella cheese

	Low Moisture Full Fat	Low Moisture Part Skim	USDA Lowfat
% Fat	24.6	17.1	7.9
% Protein	21.6	27.5	31.2
% Salt	1.2	1.5	1.4
Calories/oz	90	79	58
% Calories from Fat	69	55	34

TABLE 3—Lowfat Mozzarella specifications provided to AMS

9-10% Fat
56-58% Moisture
62-64% Moisture in Nonfat Substance
1.3-1.5% Salt
pH 5.1-5.3
Schreiber Meltability 1.5-1.8

of the lowfat pizzas. A set of specifications for lowfat Mozzarella has been supplied to the Agricultural Marketing Service (Table 3), which will conduct a test buy of this cheese in early 1995.

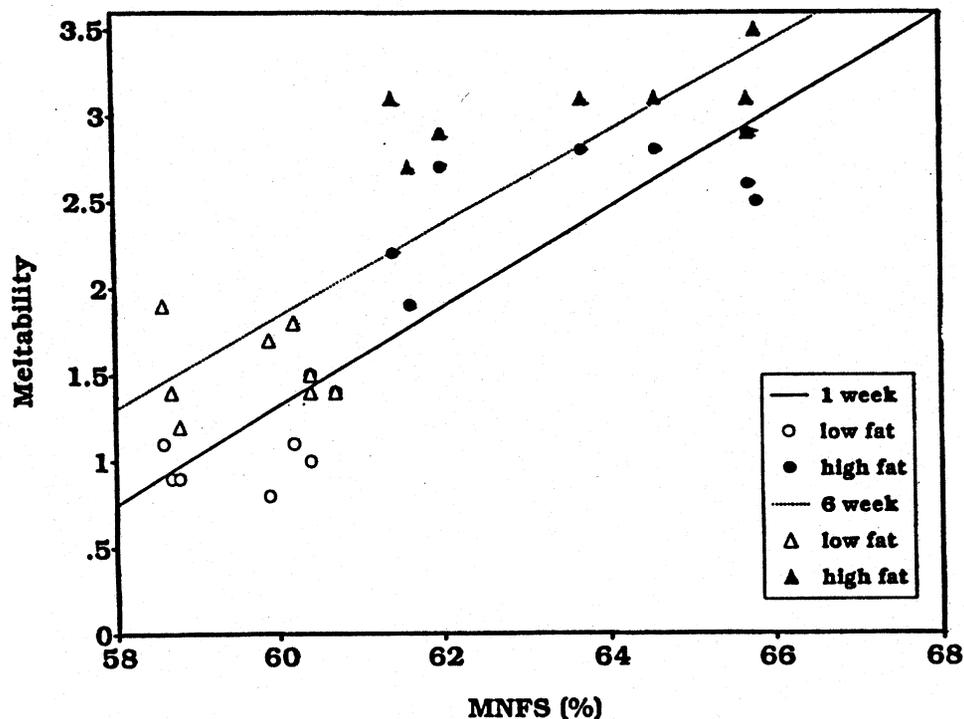


FIG. 4—Meltability vs percentage of moisture in nonfat substance (MNFS) in lowfat and full fat Mozzarella cheeses. A value of 1.0 represents no expansion of a 37-mm diameter disk of cheese that has been heated at 232°C for 5 min. A value of 2.0 represents an expansion of diameter of 10 mm.