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NUTRITIONAL ASPECTS OF REDUCED-FAT CHEESE

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INTRODUCTION

In response to consumer demand, the dairy industry has been developing new reduced and nonfat products to help meet dietary goals of reducing fat and calories. Because of its high fat content, cheese is a prime target for fat reduction, and offers great opportunities to market new varieties perceived as "healthy", provided the reduced fat cheese is organoleptically acceptable.

The U.S. consumer is well aware of cheese's nutritional reputation and the per capita consumption of cheese has been steadily increasing. Cheese is acknowledged as a major source of calcium in the diet and also contains a good supply of Vitamin A and riboflavin, as well as high quality protein. In the past 20 years, cheese consumption in the U.S. has doubled; in 1992, 11.8 kg/person were consumed. Particularly striking has been the increase in Italian cheese consumption, from 1.2 kg/person in 1972 to 4.5 kg/person in 1992 (USDA, 1993). Americans are eating about 0.3 kg cheese of all varieties/week.

Cheese is frequently manufactured or processed further into process cheese of various types, usually referred to in the United States as "American" cheese. These cheeses are popular because they melt smoothly, and are bland and sweet in flavor. Comparative data for natural Cheddar cheese and process cheeses are listed in Table 1. Such cheeses are manufactured under Standards of Identity (CFR, 1992), where minimum fat and maximum moisture levels are specified. The natural Cheddar cheese contains about 10% more protein and 15% more calcium than its nearest counterpart, "American" cheese. A one-ounce slice of "American" cheese provides about 160 mg of calcium. On the negative side, the same one-ounce slice provides nine grams of fat, equivalent to about two pats of butter. Even the process cheese labelled "Lite" provides 49% of its calories from fat. Process cheese also tends to be higher in sodium than the natural cheese containing 200 to 300 mg or more per slice (*Consumer Reports*, 1990).

LIGHT DAIRY PRODUCTS

Consumer concerns about the levels of fat and cholesterol in their diets have brought about the development of a large array of lowfat and nonfat dairy foods. According to a

Table 1. Comparison of natural Cheddar cheese to process varieties.

Variety	% Cheese	Additives	% Calories from fat
Cheddar	100	—	74
"American" cheese	90	Salts, cream, water	75
Cheese food	51-65	Water, skimmilk, nonfat dry milk, buttermilk, whey	67
Cheese spread	51-65	As above plus gums, water, sweeteners	66
Cheese product "Lite"	40-50	Added solids-not-fat to raise protein, calcium, more water	49
Imitation cheese	May be zero	Water, casein, vegetable oil, flavors	67

Source: *Consumer Reports* (1990)

Gallup Poll*, reasons for use of these products include staying in better overall health (86%), reducing calories (85%), reducing fat (83%), reducing cholesterol (79%), reducing sugar/carbohydrates (76%) and maintaining correct weight (72%) (*Calorie Control Commentary*, 1990). In 1991, sales of these products represented more than two-thirds of all sales of lowfat low cholesterol products (*Food Processing*, 1993).

Dairymen have known for years how to reduce the fat content of dairy foods: put the starting milk through the cream separator! One example of a reduced fat product from a simple milkfat removal is a sour cream alternative prepared with cream containing 9% milkfat, skimmilk and whey protein to yield a product with less than half the fat content while maintaining the taste and texture expected of a full fat product (Food Fats and Health, 1991). However, the manufacture of acceptable high quality lowfat or nonfat cheese is probably the most technologically challenging of all dairy foods. In spite of this, in the past several years, a wide assortment of reduced fat and nonfat cheeses and cheese foods have appeared although the category represents only 2.5 to 5% of the market (Burros, 1992).

Reduced Fat and Nonfat Cheese

Levels of fat in cheese have a direct impact on flavor acceptability and desirable phys-

ical properties. Although reducing the fat content of Cheddar cheese, for example, by 33%, yielded acceptable Cheddar-type cheeses, further reduction by 50% or more had a severe adverse effect on its desirable physico-chemical and sensory qualities (Olson and Johnson, 1990). Natural cheeses such as Cheddar or Swiss form an elastic rubbery texture and develop little if any flavor. If reduced fat content is coupled with reduced salt, there is a geometric decline in flavor acceptability.

Milkfat has multiple functions in cheese, affecting especially the physical properties; fat removal has many deleterious effects on the desirable characteristics of cheese. These aspects will be discussed in later chapters in this volume. From a nutritional standpoint, however, milkfat functions as a carrier for the fat soluble vitamins. As natural cheese is viewed as a good source of Vitamin A, fortification is needed if lowfat or nonfat cheese is to be nutritionally equivalent to the natural product.

Removal of fat can result in cheese with more calcium, phosphorus and protein, as listed in Table 2, where the compositions of two nonfat cheeses are compared to that of natural Cheddar. The data were obtained from the nutritional labelling on packages of cheese purchased at a local supermarket. In Nonfat 1, the protein content is higher and, in Nonfat 2, lower. Fat has been removed; less than one-half of one gram remains in a one-ounce serving. Cholesterol content of both nonfat products is one-sixth that of the natural cheese. Significantly, the sodium content is 1.5 or 2 times higher, suggesting that salt may be substituting for flavor.

Table 2. Composition of fat-free cheeses.

Component	Natural Cheddar	Nonfat 1	Nonfat 2
	---------- g/1 oz serving ----------		
Protein	7	8	6
Carbohydrate	1	1	4
Fat	9	0	0
Cholesterol	30[a]	5[a]	<5[a]
Sodium	180[a]	290[a]	380[a]

[a]mg/1 oz serving

Table 3. Percent recommended daily allowance in fat-free cheeses: one-ounce serving.

Component	Natural Cheddar	Nonfat 1	Nonfat 2
Protein	15	20	15
Calcium	20	20	20
Riboflavin	6	6	6
Vitamin A	6	6	6
Kcalories	110	40	40
% of calories from fat	70	4	----

The percentage of recommended daily allowances for each of these products is listed in Table 3. These nonfat products have both been fortified with Vitamin A palmitate for nutritional equivalency. As these cheeses are processed from skimmed milk cheeses, the calcium content is equivalent. The percentage of calories from fat is greatly reduced.

As previously mentioned, reduction in milkfat content not only affects the physical properties of cheese, but also much of the flavor either is altered or disappears completely. Olson and Johnson (1990) have reported that acceptable Cheddar-type cheese may be made with a 33% reduction in fat; consequently, reduced-fat cheeses are also commercially available, several of which are claimed to have good Cheddar flavor (Burros, 1992).

Data listed in Table 4 compare the fat content of reduced-fat ("light") cheeses to that of natural Cheddar cheese. These data were calculated from data reported by Burros (1992). The "light" products were all reported to have good Cheddar flavor.

Table 4. Comparison of milkfat content of reduced-fat Cheddar-type cheeses to that of natural Cheddar.

Component	Natural Cheddar	Light 1	Light 2	Light 3
Milkfat, %	31.6	17.6	14.1	17.7
Kcalories/100 g	387	282	247	317
Calories reduced, %	----	27	36	18
Milkfat reduced, %	----	44	55	44

Calculated from Burros (1992)

Examination of the data of Table 4 quickly show that, although the fat content may be reduced by as much as 55%, the reduction in total calories is not what many consumers might expect. The percentage reduction in energy ranged from a low of 18% to a high of 36%.

Nutritional Implications of Fat Mimetics

Many nonfat or reduced fat cheeses contain fat substitutes to enhance the body and texture that is significantly altered by removal of milkfat. Fat substitutes reported on the labels of the nonfat cheeses described in Table 2 and 3 consisted of mixtures of guar gum, xanthan gum, carrageenan and water for Nonfat 1 and cellulose gel, whey, skimmilk, cellulose gum, guar gum and carrageenan for Nonfat 2. The gums and gels listed are considered to be non-caloric. However, if a microparticulated protein is used as a fat mimetic, its calorie content should be considered. For example, the energy value of Simplesse R™ (NutraSweet Co., Deerfield, IL) is reported as 1.3 Kcal/g; the protein efficiency ratio of this product, as assessed with rat feeding trials, is greater than that of casein (Kretchmer, 1991). This would appear to be a very desirable product nutritionally to use as a fat mimetic in cheese since it is a dairy protein-based material, processed from cheese whey protein and, in some cases, egg albumin. It has been estimated that maximum usage of all proposed microparticulated protein-containing foods by the consumer would result in a mean fat reduction of the current U.S. diet by about 14% (Young, et al., 1990).

One aspect of the nutritional importance of cheese arises from its content of biologically valuable proteins. Renner (1993) reports that a 100-g portion of soft cheese

provides 30-40% of the daily protein requirement of an adult and 100 g of a hard cheeses will supply 40-50%. A comparison of the concentration of some essential amino acids in cheese protein with total milk protein is shown in Table 5. Cheese protein meets the requirement for essential amino acid as well as total milk protein except for being slightly low in methionine + cystine.

Table 5. A comparison of some essential amino acids in total milk protein and cheese protein.

Amino acid	Total milk protein	Cheese protein
	g/100 g	
Tryptophan	1.4	1.4
Lysine	8.3	8.3
Methionine + cystine	3.6	3.2
Threonine	5.1	4.8
Phenylalanine + tyrosine	10.5	10.9

Source: Renner (1993)

If the cheese milk is concentrated by ultrafiltration up to the dry matter content of the cheese so that no whey is produced, the whey proteins are also incorporated into the cheese. They are nutritionally superior to casein, which represents about 95% of the total protein in the cheese, because of their better balance of essential amino acids. Casein, as shown in Table 5, is slightly low in sulfur-containing amino acids, so incorporation of whey proteins into the cheese will improve the nutritional quality. While in a normal cheese, the whey protein content may only be about 2-3% of the total, in a cheese made from ultrafiltered milk, they may represent 15% of the protein (Renner, 1993).

Examination of the scientific literature gives little information about the nutritional implications of other biopolymer-based fat mimetics or synthetic fat substitutes in cheeses. This is a research area that requires additional exploration. Fat substitutes have not yet reached the annual sales predicted by many analysts; in 1992, total sales still had not exceeded $100,000,000 (*Consumer Reports*, 1993).

CONCLUSIONS

Lowfat and nonfat cheeses appear to have a growing specialty market niche. Whereas some products attempt to simulate the full fat variety, others have unique characteristics. Although the flavor and texture of many of these new cheese products presently commercially available may be inferior to those of the natural cheese, the nutritional quality, especially of the reduced fat varieties, is not. Eating less fat is important to a healthy lifestyle. Accordingly, the future trend in cheesemaking may lie in lowering the milkfat content of cheese rather than replacing it entirely.

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