CHEESE AND ITS ECONOMICAL USES IN THE DIET.

The **Letter of Transmittal**, dated June 10, 1916, from A. C. True, Director of the States Relations Service, U.S. Department of Agriculture, to the Secretary of Agriculture, Hon. D. F. Houston, outlines the rationale for the bulletin. Given that cheese is a significant agricultural product in the United States and a widely consumed foodstuff, it was deemed desirable to study its relative nutritive value and methods for its preparation. The letter addresses a common misconception that cheese is poorly digested and causes physiological disturbances. It states that extensive digestion experiments by the Office of Home Economics, including those using a respiration calorimeter, have found these beliefs unsubstantiated. In fact, cheese was found to be thoroughly digested, comparable to other staple foods and no less digestible than meat. The Bureau of Animal Industry collaborated by providing cheese made and cured under controlled conditions for these studies. Beyond its nutritive value, the bulletin aimed to suggest dishes and combinations where cheese could replace other nitrogenous foods and fats. The bulletin was prepared by C. F. Langworthy, chief of the Office of Home Economics, and Miss Caroline L. Hunt, both experienced in nutrition. Recipes were gathered from many sources and experimentally studied by Miss Hunt. Acknowledgments are made to teachers of home economics, housekeepers, and others who contributed valuable data.

The **Introduction to Cheese as a Food** section begins by noting that cheese is likely the oldest dairy product, originating from the accidental ripening of sour milk curd. Despite its long history as a staple food for many cultures, a widespread belief persists that cheese is primarily an accessory food, suitable only in small quantities, and likely to cause physiological issues if consumed in large amounts. This perception often leads to the assumption that those who rely heavily on cheese in their diet do so out of necessity rather than choice. To address these opinions, extensive studies were conducted by the Department Work in Home Economics. These studies investigated cheese's food value, the thoroughness and ease of its digestion, its physiological effects, and its special characteristics as a food, along with methods for its preparation. The primary conclusion from this research is that cheese, when properly prepared and used, is generally not a cause of physiological disturbances. It can be readily incorporated into the diet in quantities sufficient to serve as the main source of nitrogenous food and can effectively substitute for other nitrogenous foods when desired. The bulletin compiles these findings to be helpful to all interested parties, particularly housekeepers. For housekeepers, cheese is important due to its high nutritive value (especially its high protein or muscle-

forming content), its ease of storage and preparation, its appealing flavor, and the wide variety of ways it can be served.

From an **Economic and Agricultural Importance** perspective, cheese is a significant commodity. According to the latest available census figures at the time (referenced from the U.S. Dept. Agr., Yearbook 1910, p. 359), the United States produced over 300,000,000 pounds of cheese annually, with a product value of nearly 29,000,000 and an investment exceeding6,000,000. These figures, which first separated cheese industry details from butter and condensed-milk industries, indicate substantial growth. Earlier combined statistics for the three dairy industries showed a significant advancement between 1880 and 1890, followed by continuous, steady, and healthy growth in cheesemaking. The increase in product amount and investment outpaced the growth in the number of employees, suggesting that labor-saving devices and other improvements had reduced the proportion of physical labor required, similar to trends in other manufacturing industries. Regarding the types of cheese produced in the United States (based on 1905 figures), approximately three-fourths was standard factory cheese, commonly known to retail purchasers as American cheese. A very small portion (1.1%) was skim-milk cheese, with the remainder consisting of American modifications of important foreign brands like Neufchâtel and Camembert. For retail dealers, cheese is an important and convenient product due to its high nutrient density, low water content (making it not bulky), and relative ease of preservation. The primary inconvenience for retailers is cutting exact amounts requested by customers. Efforts to address this include the production of small cheeses. Experiments by the Oregon Experiment Station explored canning cheese in pound lots, and the Wisconsin Experiment Station investigated making cheese prints similar to those used for butter. Some factories also produce 5-pound cheeses shaped like larger ones, which are convenient for families consuming large quantities and spoil less quickly than cut wedge-shaped slices. Another method to overcome cutting difficulties is the sale of cheese in pots, typically softened with butter fat or other fats to achieve a consistency suitable for use like soft cheeses.

Cheese is typically made from whole milk, with most U.S. varieties derived from cows' milk. Milk is composed of approximately 1 part solid nutrients to 7 parts water by weight. These nutrients are categorized into three main groups: protein substances (primarily casein and albumin), fat, and milk sugar.

Basic Manufacturing Process

The fundamental steps in cheese making begin with the precipitation of casein, which

constitutes over three-fourths of the milk's proteids. Rennet is added to the milk, causing the casein to form a curd. Most of the milk's fat adheres to this curd. The curd is then broken up, and the entire mixture is heated to a temperature between 96°F and 108°F. Following heating, the whey, which is the liquid portion, is drained off. The remaining curd is then salted and pressed.

This basic outline represents the essential steps, but in practice, numerous variations exist. These variations can pertain to:

- The type of milk used (e.g., cow, goat, sheep).
- The proportion of butterfat or cream retained in or added to the milk.
- The specific methods employed for separating, preparing, seasoning, and handling the curd.
- The techniques used for handling and ripening the cheese. These variations contribute to an almost endless variety of cheeses.

Role of Milk Components

During cheese making, the primary milk components undergo significant transformations:

- **Casein**: This protein is precipitated by rennet, forming the solid curd, which is the basis of cheese.
- **Fat**: Most of the fat present in the milk attaches itself to the casein curd.
- **Milk Sugar and Albumin**: The majority of the milk sugar and albumin are removed with the whey when it is drained from the curd. However, small amounts of albumin and sugar may still cling to the curd.

Fresh, moist cheese generally contains proteids and fat in a ratio similar to that found in milk. Typically, it is composed of more than one-fourth proteids, about one-third fats, and one-third water. Due to the addition of salt during the process, the percentage of mineral matter in cheese is high compared to most other foods.

Ripening and Flavor Development

After being salted and pressed, the cheese is stored in a cool place for several weeks or even longer to "ripen." During this ripening period, several critical changes occur:

- **Flavor Development**: Bacteria or other microorganisms act upon the cheese, developing its characteristic flavors.
- **Textural Changes**: The cheese undergoes marked changes in texture. Its original

pastiness may transform into a somewhat granular consistency in some types of cheese, or a waxy or buttery consistency in others.

This ripening process is crucial for the final characteristics of the cheese.

The American factory cheese, also known as American cream cheese, is of the English Cheddar type and serves as the standard among commercial varieties in the United States. Many other types are also well-known, particularly in cities and large towns with well-stocked markets.

Cheddar and American Full-Cream Cheese

Cheddar cheese, originating from the English village of Cheddar, is an old and popular type in both England and the United States. The name now more accurately describes a cheese-making process rather than a specific shape. It is made from sweet cows' milk, which can be unskimmed ("full cream"), partly skimmed, or skimmed. If cream is removed, it's designated "part-skim" or "skim." In the U.S., Cheddar-type cheese is often marketed in large, flat, round forms, typically 13 to 16 inches in diameter, 5 to 6 inches high, and weighing 26 to 32 pounds, though other shapes and sizes exist. Its color is usually pale to darker yellow but can be white if uncolored. Fresh Cheddar is mild, while well-ripened Cheddar has a characteristic sharp taste. New cheese is soft (not waxy) and can be easily shaved or broken; well-ripened cheese can be finely grated. Its distinctive flavor and wide market distribution make it commonly used. Sage cheese is a variety of Cheddar flavored with sage, characterized by a green mottled appearance, once from sage leaves but now often achieved differently.

English Dairy Cheese

This variety is important for cooks who use grated cheese. Made similarly to Cheddar, it differs in that the curd is heated to a higher temperature, resulting in a harder cheese. It typically costs more per pound than standard American factory cheese and is usually found only in larger markets.

Soft Cream Cheeses

True cream cheese is made from rich cream thickened by souring or sweet cream thickened with rennet. After whey removal by draining, it is covered, salted, and turned occasionally, becoming ready for market in 5 to 10 days. Varieties are also made with rennet from low-fat cream, and other special sorts are more common in France. The term "cream cheese" is broad, encompassing many varieties sold under special trade names,

common in most markets. Soft cream cheese compositionally has more water and fat and less protein than standard cheese, with water often making up about half its total weight. It is also more perishable. These cheeses typically sell for 10 or 15 cents each (about 40 to 50 cents a pound). Recently, varieties of soft cream cheese or Neufchâtel combined with chopped pimiento have appeared, commanding a high price but easily made at home.

Neufchâtel Cheese

Named after a town in northeastern France, this popular variety is similar in appearance and marketing to soft cream cheese. It is made from whole or skim milk curdled with rennet. After draining and pressing, it is thoroughly kneaded, formed into small rolls or blocks, and ripened for about four weeks until special molds develop. It is then wrapped in tinfoil and marketed.

Parmesan Cheese

Known as Grana in Italy, its place of origin, Parmesan is a very hard cheese. The name Grana refers to its granular appearance when broken. It is sometimes sold grated at a high price but more commonly sold ungrated. Well-made Parmesan keeps for years and can be easily broken and grated. It is widely used in Europe for serving with soups, seasoning macaroni, and similar purposes, and is quite common in American markets.

Sap Sago

This is a skim-milk cheese made in Switzerland, suitable for grating. It contains 1 pound of a Swiss-grown clover (*Melilotus cæruleus*) for every 4 pounds of cheese. It has a greenish color and an unusual flavor, and is not high-priced.

Gorgonzola and Roquefort

These are highly flavored cheeses characterized by molds throughout their entire mass. Roquefort is made from sheep's milk, while Gorgonzola is made from cows' milk.

Potted or Sandwich Cheeses

Ordinary cheese is often mixed with butter or oil, typically in a 5:1 ratio by weight (cheese to butter/oil). The mixture may be seasoned with mustard or curry powder. These cheeses, seasoned or unseasoned, are available in great variety. Potted cheese can also be easily prepared at home.

Swiss Cheese (Emmentaler, Gruyère, etc.)

In America, "Swiss cheese" is a somewhat vague term. Varieties are named after Swiss districts but are similar, characterized by a mild, sweetish flavor and large holes or "eyes." Both foreign and domestic brands are found in most markets. They are suitable for cooking and for eating uncooked, being much used this way in Europe and well-liked in the United States.

Edam Cheese

Made in Holland, Edam cheese is molded in a spherical form with a usually red-dyed exterior. In the U.S., it is customary to cut off a top section to serve as a lid, scooping out the cheese as needed. In Holland, it's often served in slices, especially when fresh. Edam is seldom used in American cookery, though thrifty housewives may stuff the hollowed shell with cooked and seasoned macaroni, rice, or similar items and bake it.

Brie and Camembert Cheese

These are very soft rennet cheeses of foreign origin, with somewhat smaller nutritive value than standard cheese. They have a strong flavor and odor. Not often used in cookery, they serve as an accompaniment to other foods. The Bureau of Animal Industry and the Connecticut Storrs Experiment Station have successfully experimented with making Camembert cheese.

Cottage Cheese

Cottage cheese, along with other sour milk and cream cheeses, junket, Devonshire cream, and similar cheese-like products, is described in the bulletin's section on homemade cheese.

Cheese: Home Care, Food Properties, and Digestibility

The Care of Cheese in the Home

To properly care for cut cheese, it should be wrapped first in a slightly damp cloth (sprinkled and wrung out until barely damp) and then in paper. It should be stored in a cool place. Alternatively, paraffin paper can be used instead of the damp cloth. If cheese is placed in a covered dish, the air should not be entirely excluded, as this can promote molding.

For small whole cheeses, a satisfactory method of keeping them is to cut a slice from the top to serve as a cover. The cheese can then be removed as needed using a knife, a strong spoon, or a cheese scoop. Hardware stores sell knobs that can be inserted into this top slice to make it easier to handle. The cheese beneath this cover should be kept wrapped in a cloth.

Cheese as a Food (General Uses)

Cheese is generally used in two ways: in small quantities primarily for its flavor, and in larger quantities for its nutritive value as well as its flavor. Some cheese varieties are mainly used for flavor, many of which are high-priced and contribute little to the overall food value of the diet due to the small amounts consumed. However, they play an important role in making the diet attractive and palatable. An intelligent housekeeper views these as "the region of choice," selecting them after ensuring the family's basic nutritional needs are met.

Other cheeses, suitable for consumption in large quantities and relatively low-priced, are important for both flavor and nutritive value. Standard factory cheese, commonly known to housewives as American cheese, is preeminent among these. When "cheese" is mentioned without further specification in this document, it refers to this variety.

The Flavor of Cheese

The flavor of cheese is derived from several components:

- Fatty acids and their compounds.
- Ammonia-like bodies formed from the cleavage of casein during ripening.
- Salt added to the curd.
- In some varieties, like Roquefort, bodies elaborated by molds that develop in the cheese.

Highly flavored cheeses have an abundance of strong-smelling fatty acids and ammonia-like bodies. For instance, a trace of ammonia flavor can often be detected in Camembert. The breakdown of nitrogenous material and other changes in cheese are primarily due to enzymes originally present in the cheese or from microorganisms. These are considered fermentative changes, not putrefactive. While the preference for strongly flavored and odorous cheeses is individual, there is no chemical basis for the common assertion that such cheeses have undergone putrefactive decomposition.

Composition of Cheese and Some Other Foods Compared

For practical purposes, a housekeeper can consider cheese to be composed of approximately equal parts by weight of proteids (proteins), fats, and water. This understanding helps classify cheese with high-protein foods and also with foods rich in fat, preventing its unnecessary combination with other fatty foods.

A comparison of the average composition of cheese and other common foods is presented below:

Average composition of cheese and some other common foods as purchased, and also on the basis of edible portion.

Food materials.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Calories.
Cheese.		34.2	25.2	33.7	2.4	3.8	1,950
Beef of average composition as purchased.	18.6	50.5	15.2	15.5		.7	935
Edible portion		62.2	18.8	18.8		.9	1,145
Porterhouse steak as purchased.	12.7	52.4	19.1	17.9		.8	1,110
Edible portion...		60.0	21.9	20.4		1.0	1,270
Loin steak, broiled, edible portion.		54.8	23.5	20.4		1.2	1,300
Dried beef.		53.7	26.4	6.9		8.9	790
Eggs as purchased.	11.2	65.5	13.1	9.3		.9	635

Edible portion.		73.7	13.4	10.5		1.0	720
Milk...		87.0	3.3	4.0	5.0	.7	310
Bread.		35.3	9.2	1.3	53.1	1.1	1,215
Potatoes as purchased	20.0	62.6	1.8	.1	14.7	.8	295
Edible portion...		78.3	2.2	.1	18.4	1.0	385
Apples as purchased.	25.0	63.6	.3	.3	10.8	.3	190
Edible portion.....		84.6	.4	.5	14.2	.3	290

From this table, cheese has nearly twice as much protein by weight as beef (average composition as purchased) and more than twice its fuel value. Compared to porterhouse steak (as purchased), cheese contains over 25% more protein and nearly twice as much fat. Cheese contains 3.8% ash, a considerable part of which may be salt added during cheese making. The ash in cheese, like that of milk, is primarily characterized by calcium (lime), magnesium, phosphorus, and iron. Average values from earlier department bulletins show cheese contains 1.24% calcium oxide, 0.049% magnesium oxide, 1.49% phosphorus pentoxide, and 0.0015% iron.

Nutritive Value and Cost of Cheese

While the body needs a relatively small amount of mineral matter daily, it is very important. A reasonably varied and generous mixed diet usually supplies all necessary ash constituents. If calcium and phosphorus are lacking, they can be increased by consuming milk and milk products like cheese and junket, without reducing palatability or significantly increasing cost.

Comparing the nourishment obtained for a fixed sum (e.g., 10 cents) across different foods is difficult due to varying market prices. However, assuming certain prices allows for comparison. The following table shows the protein and energy value obtained for 10 cents when cheese is 22 cents per pound, compared to other common foods at assumed prices:

Amounts of protein and energy obtained for 10 cents expended for cheese and

other foods at certain assumed prices per pound.

Food materials.	Price.	10 cents will buy	10 cents' worth will contain—	
			Proteid.	A fuel value of
		Ounces.	Ounces.	Calories.
Cheese.	22 cents per pound..	7.3	1.9	886
Beef, average.	20 cents per pound..	8.0	1.2	467
Porterhouse steak.	25 cents per pound..	6.4	1.3	444
Dried beef.	do.	6.4	1.6	315
Eggs.	24 cents per dozen...	10.0	1.3	198
Milk.	9 cents per quart..	38.3	1.2	736
Wheat bread.	5 cents per pound	32.0	2.9	2,400
Potatoes.	60 cents per bushel..	160.0		2,950
Apples.	1½ cents per pound..	106.7		1,270

Since cheese is ready-to-eat, comparing its composition to cooked beef (freed from bone and superfluous fat, as served at a table) is relevant. Weight for weight, cheese has appreciably more protein and 50% more fat than such cooked beef.

Compositionally, cheese is directly comparable to meat. It is used this way in some parts of Europe and was formerly used so by many groups. Its less common use as a primary food in the United States is attributed to several factors:

1. Habit, where a meal feels incomplete without meat.
2. Cheese has a more pronounced flavor than meat, making it less likely to be universally acceptable as a chief food for a meal, as some family members may not relish it in quantity.

3. A common belief that cheese is indigestible.
4. Housekeepers often lack experience and skill in incorporating cheese as a central food in bills of fare compared to meat.

The Digestibility of Cheese

Contrary to the common belief that cheese causes digestive disturbances, recent research by the Office of Experiment Stations in cooperation with the Bureau of Animal Industry disproves this. Experiments involving young men in good health on a diet of bread, fruit, and American factory cheese (made with varying rennet amounts and at different ripening stages) showed high digestibility.

- Over 90% of the nitrogenous material (protein) in the cheese was digested (retained in the body).
- Nearly 90% of the energy supplied by the cheese was available. These results indicate that cheese compares favorably with other foods in terms of thoroughness of digestion. Furthermore, cheese consumption did not cause constipation or other physiological disturbances. These findings for full-cream cheese were practically replicated in experiments with skim-milk cheese, Swiss cheese, Roquefort cheese, Camembert cheese, and cottage cheese. Artificial digestion experiments at the Minnesota Agricultural Experiment Station also indicated that cheese protein is digested.